

**A COST-EFFECTIVENESS APPROACH TO CALCULATING SROI  
FOR INTEGRATED AND INTEROPERABLE  
HEALTH AND SOCIAL SERVICES  
IN A LOCAL HEALTH AND HUMAN SERVICES DEPARTMENT**

by

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## **Abstract**

### **Background**

Human services and welfare systems are essential elements of modern day societies. When operated efficiently, they provide a safety net for citizens who are unable to provide for themselves. Traditionally, the development of these programs has been independent of each other and each has its own separate legacy system of funding mechanisms, legal frameworks, management, bureaucracy, and information systems. However, overlaps in the scopes of these programs allow for redundancies and ultimately waste of program resources, and result in under coverage of their target populations, and at times the growth of social disparities and inequalities- exactly the opposite of what these programs were designed to reduce.

With the rapid growth of information technologies (IT) and electronic communication networks, interoperability has emerged as a potential solution to the problem of silo welfare programs. Local health and human services departments are being encouraged to adopt a “no wrong door” approach under which their clients, regardless of the service the client applies for, can receive an array of needed services. The Intensive Case Management Calculator (ICMC) uses a cost effectiveness approach to calculate the Social Return on Investment (SROI) of the implementation of interoperable health and human services systems.

### **Methods**

The ICMC, as developed, uses six specified personas, interviews with county healthcare executives, and a systematic literature review to gather evidence on the costs and benefits of the implementation of interoperability (To Be) and the lack of interoperability (As Is). The six personas represent complicated cases that use multiple services, and would potentially benefit the most from

interoperability. These include ‘A child aging out of disabilities program’, ‘A pregnant teenager’, ‘A child aging out of foster care programs’, ‘A homeless young adult’, ‘A homeless family’, and ‘A homeless adult’.

The ICMC employs a decision-tree-based model to compare the expected costs and benefits and to calculate the value added from interoperability. For a complete social perspective required for a Social Return on Investment (SROI) model, the ICMC considers three perspectives: client, social direct, and social indirect in addition to a total social perspective. The ICMC also performs a sensitivity analysis of the results, in addition to baseline costs and benefits. In order to test the robustness of the ICMC in accommodating various personas, after the development of the original ICMC, a modified ICMC was developed and tested with a newly created persona of ‘A victim of domestic violence’ replacing the persona of ‘A child aging out of disabilities program.’ The use of the modified ICMC allowed for the external verification and the retrofitting of the ICMC.

## **Results**

The base-case analysis shows that, with the exception of children aging out of foster care, and the homeless youth personas, for all personas, an investment in interoperability is more costly than the alternative of no investment. However, from the total social perspective, the benefits of implementing interoperability exceed the costs for all personas. Beside the Homeless Family persona, the cost of implementing interoperability is below the chosen Willingness to Pay (WTP) threshold of \$100,000 per client improved. The sensitivity analysis reveals broad ranges for the estimation of costs and benefits. Many of the cost ranges exceeded the WTP by multiples of ten or even one hundred folds.

## **Conclusion**

Since the expected benefits of this investment are greater than the expected costs, and the expected costs per client “saved” are less than the WTP, investment in interoperability is prudent.

Given the broad ranges of the sensitivity analysis results, careful, and continuous formative evaluation of the costs and the outcomes is highly recommended. Managers should give emphasis to the continuous evaluation of parameters that the sensitivity analysis deems may have the largest impact on the total investment results.

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In choosing the institution to pursue my doctoral education I had in mind that a university is a far more greater organization than just classrooms, individual papers and reports. The opportunities for professional growth at this unique institution are so vast that at some point, when I first arrived at the Johns Hopkins Bloomberg School of Public Health, I wrote an opinion that a student of public health at Hopkins, is like a kid in a candy store. Today the numerous friendships I have developed here, have enriched that belief.

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# Table of Contents

Abstract .....	ii
Background.....	ii
Methods .....	ii
Results.....	iii
Conclusion.....	iii
Acknowledgements .....	v
Dissertation Committee.....	xiii
Table of Contents.....	xiv
List of Tables.....	xx
List of Figures .....	xxiii
List of Acronyms .....	xxvi

Chapter 1 - Introduction .....	1
Background.....	4
Goals and Specific Aims .....	6
Research questions, and operational goals.....	7
Significance.....	9
Depiction of the dissertation and outline.....	11
Chapter 2 – An approach to Social Return on Investment (SROI) .....	15
Introduction .....	15
Objective.....	19
Methods .....	20
Results.....	21
Review of the theoretical framework.....	22
The Government IT SROI Framework (Cresswell, et al., 2006) .....	22
Conclusion.....	29

Chapter 3 – Social Return on Investment (SROI) Model Development for the original Intensive Case Management Calculator (ICMC).....	30
Background.....	30
Objective.....	32
Conceptual framework (As-Is vs To-Be: The eICM framework) .....	33
Proposed theoretical model for calculating SROI .....	36
Assumptions of the ICMC SROI model.....	37
a) Setting .....	37
b) Target Population for the SROI model.....	39
c) Alternatives .....	40
d) Outcomes .....	40
e) Uncertainties and Probabilities.....	41
f) Perspectives.....	41
g) Time horizon .....	42
h) Structure .....	42
i) Desires and Tradeoffs.....	44
Protection of human subjects.....	46
Methods .....	48
1. Scope and Stakeholders .....	48
2. Mapping outcomes.....	50
3. Evidencing the outcomes and giving them value .....	50
4. Establishing impact .....	52
5 Assigning cost values to services and outcomes; .....	55
6 Assigning probabilities to probabilistic values of services and outcomes.....	55
7. Calculations.....	64



Chapter 4 – Original ICMC Results.....	68
Introduction .....	68
Findings from the interviews.....	69
Parameter Values from the Literature .....	71
Results of the original ICMC with the original six personas .....	74
Text Results.....	74
Values generated .....	78
Graphical Results .....	83
Sensitivity analysis results .....	87
Conclusion.....	91
Chapter 5 - ICMC Model Verification.....	92
Background.....	92
Objective.....	93
Conceptual framework.....	94
Development of a modified ICMC .....	95
Assumptions .....	96
Protection of human subjects .....	99
Methods.....	100
A comparison of the results of the original and modified ICMC .....	132
Conclusion.....	136

Chapter 6 - Discussion .....	138
Introduction .....	138
A critical discussion of the ICMC .....	139
Question 1- Title .....	139
Question 2- Objectives .....	140
Question 3- Alternative .....	141
Question 4- Description of Alternatives .....	142
Question 5- Perspective .....	142
Question 6- Study Type .....	144
Question 7- Relevant Costs .....	145
Question 8- Relevant Outcomes .....	146
Question 9- Discounting .....	148
Question 10- Assumptions .....	148
Question 11- Sensitivity Analysis .....	150
Question 12- Limitations .....	153
Question 13- Generalizability .....	154
Question 14- Unbiased Conclusions .....	155
Specific strengths and shortcomings of the ICMC .....	159
ICMC strengths .....	159
ICMC shortcomings .....	160
A- Defining the impact specifically .....	160
B- Classical threats to validity .....	161
C- Lack of the standardization of spiraling (up or down) .....	162
D- Under calculation of the value of personal connection and social mobility .....	164
Summary of major strengths and weaknesses .....	165
Suggestions for future studies .....	166
Bibliography .....	168

Appendix.....	183
IRB Exemption of Human Subjects Research Approval.....	183
Evidence Table 1 .....	184
Evidence Table 2 .....	195
Evidence Table 3 .....	218
Curriculum Vitae .....	246

## List of Tables

Table 1.1- Interoperability components of MC DHHS .....	5
Table 2.1- Stakeholder Value Matrix(Cresswell, et al., 2006) .....	26
Table 3.1- Summary of MC DHHS client personas*.....	39
Table 3.2- MC DHHS Outcomes defined*.....	41
Table 3.3- Spiral Up and Spriral Down conditions of personas* .....	49
Table 3.4- Services, and micro services for a homeless family persona.....	51
Table 3.5- Return on Taxpayer Investment (ROTI) worksheet (Accenture)* .....	52
Table 3.6- Query keywords used in the systematic review .....	57
Table 3.7- Data integration for the persona of a homeless family.....	65
Table 3.8- Calculations and parameter derivations for homeless family persona .....	66
Table 4.1- Life of the case time difference between As Is and To Be* .....	69
Table 4.2- Calculation of the per client cost of implementing interoperability.....	70
Table 4.3- Breakdown of reviewed articles of the systematic review .....	71
Table 4.4- Use of literature data in the ICMC .....	73
Table 4.5- Text report of cost-benefit analysis for total social value for all personas	75
Table 4.6- The costs and cost-consequences from the original ICMC.....	77
Table 4.7- The ‘client’ value and cost-benefit from the original ICMC.....	79
Table 4.8- The ‘direct social’ value and cost-benefit from the original ICMC.....	80
Table 4.9- The ‘indirect social’ value and cost-benefit from the original ICMC.....	81
Table 4.10- The ‘total social’ value and net benefit from the original ICMC.....	82
Table 5.1- Summary outcomes for a victim of domestic abuse.....	108
Table 5.2- Valuation of Interoperable services for the mother.....	109

Table 5.3- Valuation of Interoperable services for the children .....	110
Table 5.4- Valuation of Interoperable services for the spouse .....	110
Table 5.5- Probability of Spiral Up under As Is and To Be .....	113
Table 5.6- Annual income of mother under Spiral Up/Down .....	113
Table 5.7- The cost of victim of domestic violence services offered by MC DHHS* .....	114
Table 5.8- Calculation of bundled costs .....	115
Table 5.9- Monetary values of permutations of conditions from varied perspectives .....	117
Table 5.10- The costs and cost-consequences from the modified ICMC .....	121
Table 5.11- The ‘client’ value and cost-benefit from the modified ICMC .....	122
Table 5.12- The ‘direct social’ value and cost-benefit from the modified ICMC ....	123
Table 5.13- The ‘indirect social’ value and cost-benefit from the modified ICMC .	124
Table 5.14- The ‘total social’ value and net benefit from the modified ICMC .....	125
Table 5.15- Check table of differences between the original and the modified ICMC .....	133
Table 6.1- Comparison of variable effect on total sensitivity analysis of the model (Lehmann, 2014a) .....	152
Table 6.2- A summary of cost and effect measures .....	158
Table 6.3- Comparison of original ICMC results from various perspectives.....	159
Table 6.4- Spiral condition comparison for two personas.....	163
Table 0.1- League table of theoretical papers.....	184
Table 0.2- League table of cost papers.....	195

Table 0.3-League table of statistical sources .....	218
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## List of Figures

Figure 1.1- "The tower of achievement" of informatics studies (Friedman, 2013) ....	11
Figure 1.2- The scope of the dissertation .....	12
Figure 2.1- Steps in applying the public value framework (Cresswell, et al., 2006) ....	22
Figure 2.2- The Mixed Direct, Indirect Service and Environment model (Cresswell, et al., 2006) .....	24
Figure 2.3- Public Return on Investment Value Chain (Cresswell, et al., 2006) .....	26
Figure 2.4- The Public Value Framework Overview (I) .....	27
Figure 2.5- The Public Value Framework Overview (II)(Cresswell, et al., 2006) .....	28
Figure 3.1- As Is service delivery model of DHHS.....	33
Figure 3.2- The "Life of the Case" Workflow Analysis Model (Maryland DHR, 2012) .....	34
Figure 3.3- Montgomery County DHHS Organizational Chart .....	38
Figure 3.4- The decision tree model for calculating the value of interoperability.....	43
Figure 3.5- Probability of receiving service in consecutive years.....	67
Figure 4.1- ICMC Dashboard.....	74
Figure 4.2- Cost-consequence graph of ‘Aging out of Foster care’.....	83
Figure 4.3- Cost-consequence graph of ‘Pregnant Teen’.....	84
Figure 4.4- Cost-consequence graph of ‘Aging out of disabilities’.....	84
Figure 4.5- Cost-consequence graph of ‘Homeless Youth’.....	85
Figure 4.6- Cost-consequence graph of ‘Homeless Family’ .....	85
Figure 4.7- Cost-consequence graph of ‘Homeless adult’ .....	86

Figure 4.8- Sensitivity analysis of Investment costs for the Aging out of Foster Care (original ICMC).....	87
Figure 4.9- Sensitivity analysis of Investment costs for the Aging out of disabilities.....	88
Figure 4.10- Sensitivity analysis of Investment costs for the Homeless Family.....	89
Figure 4.11- Sensitivity analysis of Total Social Value and Net Benefit for Aging out of Foster Care .....	89
Figure 4.12- Sensitivity analysis of Total Social Value and Net Benefit for Aging out of Disabilities .....	90
Figure 4.13- Sensitivity analysis of Total Social Value and Net Benefit for Homeless Family.....	90
Figure 5.1- Repeat display of the Tower of Achievement (Friedman, 2013) .....	94
Figure 5.2- Position of Partner Abuse services within MC DHHS.....	96
Figure 5.3- Map of outcomes and services under As Is and To Be .....	112
Figure 5.4- Parameters of the domestic-violence persona model.....	119
Figure 5.5- Cost-consequence graph of ‘Domestic violence’ (modified ICMC).....	127
Figure 5.6- Cost-consequence graph of ‘Aging out of disabilities’ .....	127
Figure 5.7- Sensitivity analysis of Investment costs for Domestic Violence (modified ICMC).....	129
Figure 5.8- Sensitivity analysis of Investment costs for the Aging out of Disabilities .....	129
Figure 5.9- Sensitivity analysis of Investment costs for the Homeless Family.....	129
Figure 5.10- Sensitivity analysis of Total Social Value and Net Benefit for Domestic Violence (modified ICMC).....	130



Figure 5.11- Sensitivity analysis of Total Social Value and Net Benefit for Aging out of Disabilities .....	130
Figure 5.12- Sensitivity analysis of Total Social Value and Net Benefit for Homeless Family.....	130
Figure 6.1- The $\Delta C$ - $\Delta E$ curve.....	156

## List of Acronyms

Acronym	Name
ACA	Affordable Care Act
AHRQ	Agency for Healthcare Research and Quality
As Is	Pre interoperability
BAK	Betty Ann Krahne Shelter
CI	Confidence Interval
CMS	Centers for Medicare and Medicaid Services
DALY	Disability Adjusted Life Years
DHHS	Department of Health and Human Services
EHR	Electronic Health Record
eICM	electronic Integrated Case Management
eSARS	electronic Service Area Representatives
FEA	Federal Enterprise Architecture
HEEAP	housing, education, employment, access to healthcare, and permanent connections
HHS	Health and Human Services
HIT	Health Information Technology
HITREF	Health Information Technology Research-based Evaluation Framework
HIX	Health Insurance Exchanges
ICER	Incremental Cost Effectiveness Ratio
ICM	Integrated Case Management
ICMC	Integrated Case Management Calculator
IRB	Internal Review Board
IT	Information Technology
ITP	Intensive Teaming Protocol
JHSPH	Johns Hopkins Bloomberg School of Public Health
JHU	Johns Hopkins University
MC	Montgomery County
MC DHHS	Montgomery County Department of Health and Human Services
MD	Maryland

<b>Acronym</b>	<b>Name</b>
MeSH	Medical Subject Heading
MITA	Medicaid Information Technology Architecture
nef	New Economic Foundation
NGO	Non-Governmental Organization
NHB	Net Health Benefit
NHSIA	National Human Services Interoperability Architecture
NIEM	National Information Exchange Model
NLM	National Library of Medicine
PTM	Process and Technology Modernization
QALY	Quality Adjusted Life Years
ROI	Return on Investment
ROTI	Return on Taxpayer Investment
SNAP	Supplemental Nutrition Assistance Program
SROI	Social Return on Investment
TANF	Temporary Assistance for Needy Families
To Be	post interoperability
WoS	Web of Science
WTP	Willingness to Pay
WHO	World Health Organization

## Chapter 1 - Introduction

Health and human services systems are essential elements of modern day societies (Arrow, 1950, 1963; Rawls, 1971). When they operate efficiently, they provide a safety net for citizens who are unable to provide for themselves. In the United States, the Social Security Act of 1935 brought much needed relief to the suffering families of the Great Depression of the 1920's, and became the centerpiece of a broad range of welfare services that today give service to large portions of the American society. Today the overall share of federal money spent on welfare benefits including Social Security, Medicare, Income Security, Health, and Veterans Benefits is nearly \$2.3 trillion annually, which accounts for slightly less than two-thirds of the total 2011 US Federal Budget (Carter, 2012; Carter & Cox, 2010, 2011).

Obviously, the management of such funds requires a large bureaucracy of organizations, programs, projects, and people that stand between the halls of Washington, and the state and local county level officials who disperse and use the funds. However, as it is well known, the pipeline between fund allocation and benefits distribution and consumption is often far from linear. This pipeline involves an immensely complex network of communications, with a magnitude of nodes, which not only connect indirectly, but also sometimes lack connectivity all together. Such lack of communications can lead to inefficiencies that ultimately affect the well-being of the benefit recipients such programs were designed and are currently budgeted to serve.

Traditionally, with the most positive intentions, the belief that specialization of the scope of a social-service program can lead to its better design and effectiveness led to the independent development of these programs (The Midwest Welfare Peer Assistance Network (WELPAN), 2002). Over time, however, these programs have evolved into what is today an obvious maze of fragmented silos, each with its own separate legacy system of funding mechanisms, legal

frameworks, management, bureaucracy, and information systems (The Midwest Welfare Peer Assistance Network (WELPAN), 2002). This separation occurs while there is a significant overlap in many of the functions, and more importantly, many of the clients of welfare programs. Such overlaps allow for many redundancies, which ultimately waste program resources, and result in under coverage of the service population, and at times the growth of social disparities and inequalities- exactly the opposite of what human services programs were designed to reduce.

On the client side, today low-income families in the United States face a multitude of challenges in obtaining their most basic human needs, which would give them the framework to build socially sustainable livelihoods. Ironically, this complexity of challenges occurs while officially there is a government program that addresses each of these needs. If there are problems with housing, nutrition, health, and education, there are programs for low-income housing, home energy assistance, Supplemental Nutrition Assistance Program (SNAP), Medicaid, Education, and Temporary Assistance for Needy Families (TANF), as well as childcare, and alcohol and drug treatment programs. While most of the programs operate in silos, the needs of low-income families are not mutually exclusive. Drug dependence, chronic hunger, and malnutrition change and challenge one's healthcare needs, and a house with no utilities is not a house that would bring peacefulness and strengthen a modern family. In practical terms, today a low-income family who lives in a America has to deal and negotiate with multiple bureaucracies that may be sending it messages that are conflicting and contradictory to its overall wellbeing and productivity.

The magnitude of the implications of the non-integrated service delivery problem is not small. Two-thirds of the annual Federal budget is spent on human services, and in every single state, there is 20-30% of the population that receives some form of human services (Carter, 2012; Carter & Cox, 2010, 2011). Forty percent of all current federal, state and local spending is related to human services (Carter, 2012). The federal government's direct fiscal contribution to human

services through the Administration for Children and Families (ACF) totals more than \$51 billion annually, with \$9 billion - or just under 20 percent - directed towards the cost of technologies to track, manage and analyze service trends (ACF Office of Legislative Affairs and Budget, 2014). Such tremendous expenditures, however, have not led to equally comparable results.

While the majority of funding is from the federal government, state and local jurisdictions are often the ones responsible for service delivery. In addition, outsourcing, and non-governmental organizations (NGO) have further complicated the problem, since none of these organizations has the technical or the delivery capacity for comprehensive care. The result has left many jurisdictions simply incapacitated to deliver the best possible outcomes for the clients and families they serve.

On the bright side, however, today the wide expansion of communication networks, coupled with the explosive growth of information technologies has begun to open new solutions for the problem of silos and non-integrated human services. Agencies and other stakeholders at various levels of government are now technically able to share large amounts of information with one another in an almost simultaneous matter via advanced online and cloud based applications coupled with secure protocols. Data sharing agreements today do not need to be complex and violate data ownerships, as they could be pre-defined so that they only cover a limited scope over limited time. Data sharing options are not limited to interoperability within a single organization or a department. Opportunities for expanding technical interoperable capabilities through multi-organizational cooperation are ready for health managers to explore and discover. Multiple organizations and departments can attempt to form cooperation projects with the objective of making siloed information interoperable so that the results of these projects fit the needs of the client in the best and most efficient way.

## Background

One of the strategic ways to overcome the problem of fragmented service delivery systems is the “no wrong door” approach (Maryland DHR, 2011). Under the no wrong door approach, a client should be able to get a referral to receive all the services, which s/he is eligible for, regardless of the service area where the first service is received (Maryland DHR, 2011). The Montgomery County Department of Health and Human Services (MC DHHS) is experimenting with the “no wrong door” approach, and served as the key locale in this study and as the model local health and human services department facing decisions related to implementing the interoperability approach. The MC DHHS recognizes that many of the residents it serves use more than one service. Therefore, the MC DHHS has adopted the statewide “no wrong door” approach that minimizes the complexity and burden of service access to its residents, regardless of the administering agency to which the client first applies (Maryland DHR, 2011). In accordance with this approach, the MC DHHS (electronic) Integrated Case Management (eICM) initiative is developing a common practice model that applies to all MC DHHS service areas, and integrates with various state and federal data systems. The primary purpose of the eICM project is to improve the core business processes and supporting technologies used by MC DHHS. The eICM plans on the incorporation of the National Human Services Interoperability Architecture (NHSIA) concepts and National Information Exchange Model (NIEM) standards so that other jurisdictions can use its findings.

The other purpose of eICM is to strengthen the existing Intensive Teaming Protocol (ITP). The ITP is a care delivery model that allows caseworkers to coordinate service delivery for clients who need the services of more than one service delivery area. MC DHHS clients participate in services delivered by nearly 120 programs that span five service areas: Aging and Disability Services; Behavioral Health and Crisis Services; Children, Youth and Family Services; Public Health; and Special Needs Housing. The interoperable eICM system plans to facilitate individual or family

access to the range of these health and human services regardless of the “door” through which they enter the system. Applicants will provide documentation only one time, instead of separately for each program for which they apply. The eICM when combined with ITP will use a modern service-oriented architecture, which allows for integration of disparate systems, will facilitate case planning and treatment for clients receiving multiple services across multiple programs, and track case progress. Table 1.1 highlights a summary of the various components of MC DHHS interoperability.

**Table 1.1- Interoperability components of MC DHHS**

<b>Organizational Component</b>	<b>Interoperability Component</b>	<b>Function</b>
<b>Computer System</b>	electronic Integrated Case Management (eICM)	Exchanging client data and information in an electronic format between caregivers.
<b>Human Resources Management</b>	Intensive Teaming Protocol (ITP)	In person communication and knowledge sharing between caregivers coordinated by a single caseworker.

The scope of the MC DHHS eICM project covers five domains:

- 1- Data Exchange and Governance Standards
- 2- Development of a Reuse and Common Services Plan
- 3- Development of a Performance Information Repository Plan
- 4- Development of a Security and Privacy Framework Plan
- 5- Return on Investment Models and Calculator

In accordance with the fifth objective, Johns Hopkins University (JHU) has developed a calculator that implements a Social Return on Investment (SROI) model. This model was designed to be sufficiently robust so that not only administrators from MC DHHS, but also from other jurisdictions, could modify and utilize it for their own interoperability projects.



## Goals and Specific Aims

The objective of this dissertation is to describe the production and verification through retro fitting of the Intensive Case Management Calculator (ICMC). The basis of the ICMC is a Social Return on Investment model. The goals of the ICMC are to:

1- Generate information that will help localities and states decide whether to implement enhanced interoperability. Interoperability is operational eICM in the form of meaningful data sharing coupled with ITP in the form of team management of client needs that a single social worker leads and coordinates.

2- To supply a computational framework and tool to enable local health and human services administrators to integrate data from their use cases (client personas) to make a coarse assessment of the gains (and costs) they would encounter through the interoperability process (and lack of it), using the paradigm of executive decision support.

3- To test the robustness of the model and the calculator in operation, by adding and calculating the results for an additional persona (beyond the models original design). This testing is to insure that administrators would be able to tailor the model to fit their needs.

## **Research questions, and operational goals.**

The key question that this dissertation addresses is what impact does interoperability make on the lives of a local health and human services department's most difficult cases? The approach taken is through a modified SROI analysis, which includes model and software development.

The reasoning for this approach is that the expectation is that eICM would generate the most value on just those clients requiring the most services. If the SROI model could not confirm that value, then either the SROI model is wrong or the clients represented by the personas are too far advanced in their needs to benefit from eICM. In the first case, the SROI model would be reviewed and in the second case the suggestion would be to target clients earlier in their downward spiral. In order to investigate the key question, this dissertation takes on four specific working aims, and each one accompanies a research question and a brief methodology.

The first specific aim is to provide a systematic appraisal of evidence on the methods of a SROI, and to identify areas where future work needs to inform the development of evidence. The research question related to this aim is what theoretical and empirical evidence is available from previous research in the areas of modeling and the social costs and SROI of implementing information technology in the public sector for human services? Chapter 2 addresses this question through a snowball literature review of the current frameworks available for the proposed Social Return on Investment (SROI) modeling.

The second specific aim is to investigate the business model of care delivery for six elicited personas and to understand the changes induced by interoperability on the business model. The research question related to this aim is what is the estimate of the overall impact of an interoperability strategy on a local health and human services department in terms of service delivery, efficiency, and outcomes? Chapter 3 addresses this question through eliciting a workflow

map, resource utilization, and presumed outcomes under the As Is (pre interoperability) and To Be (post interoperability) conditions.

The third specific aim is to articulate the cost model of care delivery for six elicited personas and to understand the changes induced by interoperability on the cost model. The research question related to this aim is how would the overall monetary impact vary under different configurations for the interoperability strategy? Chapter 3 instantiates the SROI model with costs and probabilities collected from interviews, systematic literature review, and administrative data. It also incorporates the elicited data into a computer-based SROI model.

The fourth specific aim is to test the robustness of the computer-based SROI model in accommodating varied personas. The research question related to this aim is whether the computer-based SROI model is robust to accommodate additional personas other than the six original personas, and withstand tests of verification and retrofitting. Chapter 5 develops a new persona, and repeats the methods of Chapter 3 for the additional persona and compares results with the original.

## Significance

Although both the development of the original ICMC (Chapter 3), and the modified ICMC (developed and used for verification and retro fitting – Chapter 5) use the Montgomery County, MD. Department of Health and Human Services as their exemplar, the methodology and results are applicable to various Health IT (HIT) investments in other health and human services delivery settings. The results of the combined work may find further policy relevance and importance, given recent trends of increased investments in various HIT, specifically those aimed towards increased ‘meaningful use’ (Blumenthal & Tavenner, 2010). Previous efforts on developing an interoperable health IT system in New York City have been estimated (by the RAND Corporation) to save \$147 billion per year in increased efficiency, decreased hospitalizations, and decreased medical errors (NYC Health, 2008). While the New York experiment estimated these savings in a large city with a concentrated population, their generalizability to areas of the country with lower population densities is uncertain.

In addition, the ICMC has the potential to inform DHHS managers on the costs related to their department’s interoperability investments. The knowledge gained from the use of the ICMC is consistent with the aims of the Triple Aim objectives of improving health and human services delivery through improving population health and the experience of care, as well as reducing the per capita costs of healthcare delivery (Institute for Healthcare Improvement (IHI), 2014). The Triple Aim objectives are key components of the Affordable Care Act (Berwick, Nolan, & Whittington, 2008), which has had the most impact in changing the United States health and human services delivery landscape in the past decade, and its effects are likely to continue in the foreseeable future (Molinari, 2014).

Furthermore, a report from the Agency for Healthcare Research and Quality (AHRQ) (Shekelle, Morton, & Keeler, 2006) highlights a national need for return on investment (ROI) studies

of HIT in healthcare settings. This report emphasizes the importance of empirical data and reveals the limited availability of such data:

***Predictive analyses, based on statistical modeling techniques, suggest that HIT has the potential to enable a dramatic transformation in the delivery of health care, making it safer, more effective, and more efficient. The empirical research evidence base supporting HIT benefits is more limited (Shekelle, et al., 2006).***

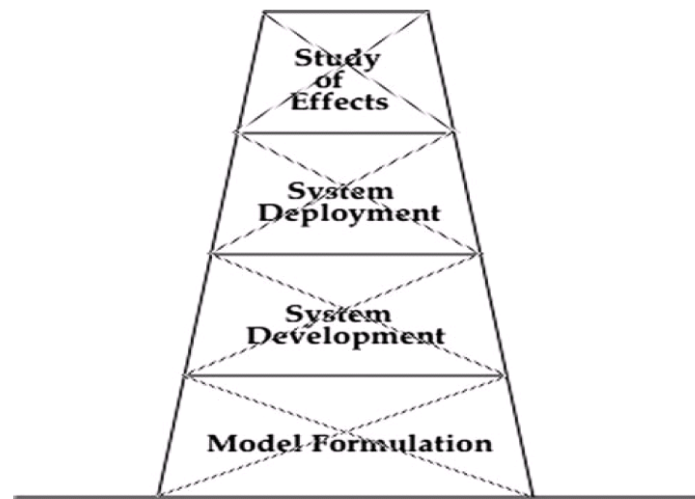
The report continues by pointing out such data need to be generalizable beyond specific health organizations:

***More widespread implementation of HIT is limited by the lack of generalizable knowledge about what types of HIT and methods for its implementation will result in changes in benefits and costs that are specific for specific health organizations (Shekelle, et al., 2006)***

Hence, this research may contribute to filling the existing gap of “lack of generalizable knowledge” specifically in the area of human services, where the multiple needs of the most vulnerable segments of the population, and continuous shortage of funding drives the need for meticulous studies completed with precise rigor.

## Depiction of the dissertation and outline

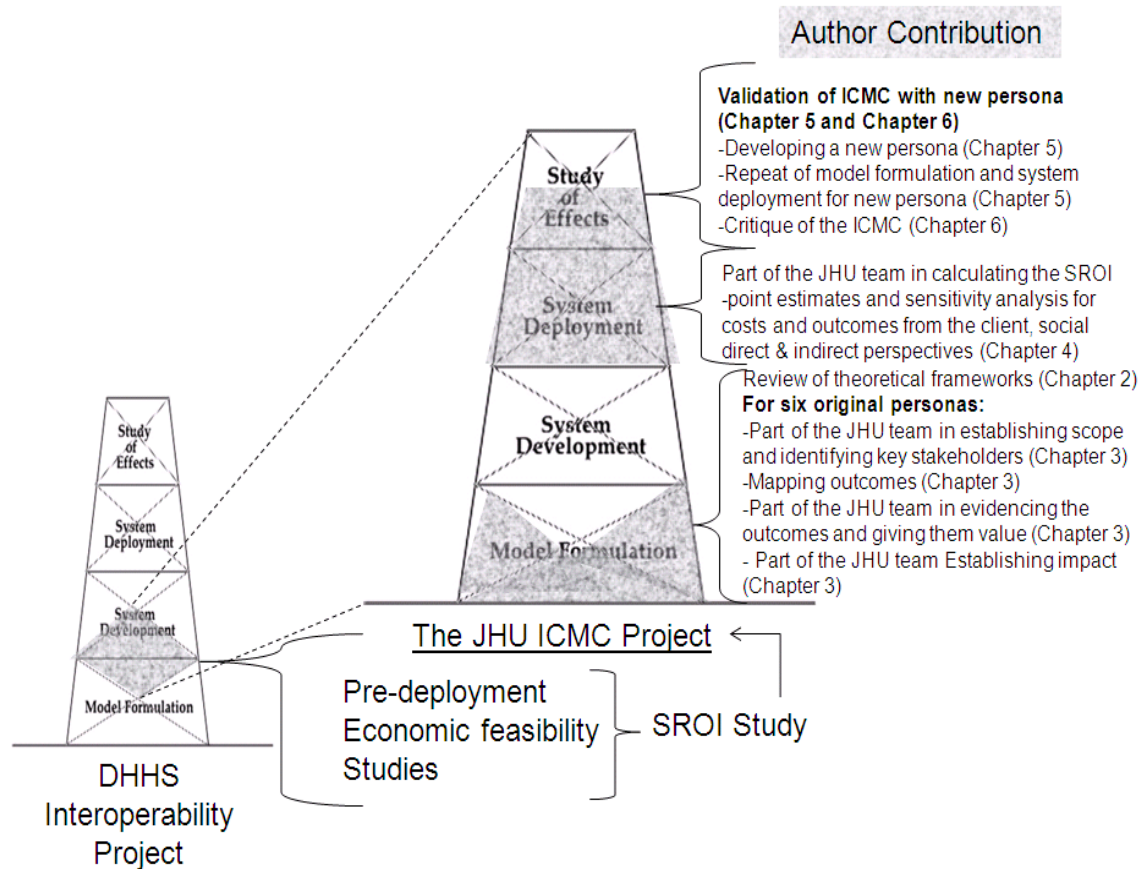
In an attempt to explain the nature of informatics studies, Friedman (2013) uses the ‘tower of achievement’ as depicted in Figure 1.1. Based on Figure 1.1 all informatics studies start with model formulation at their base and go through system development and system deployment phases to arrive at the study of effects.



**Figure 3** The ‘tower of achievement.’

### **Figure 1.1- "The tower of achievement" of informatics studies (Friedman, 2013)**

Based on the Friedman (2013) ‘tower of achievement’, Figure 1.2 reveals the scope of this dissertation. Figure 1.2 shows two towers, of which one relates to a human services interoperability project, and the second relates to the development of the Integrated Case Management Calculator (ICMC) by Johns Hopkins University (JHU). In Figure 1.2, the small tower on the left hand side depicts the human services interoperability project. The dark segment of the small tower shows that part of the human services interoperability project’s model formulation and system development involves a pre-deployment economic feasibility study. One of the components of this economic feasibility study is a SROI study. The JHU ICMC addresses this need.



**Figure 1.2- The scope of the dissertation**

The right hand side tower in Figure 1.2, which is an expansion of the dark part of the left hand side tower, depicts the JHU ICMC project. The author of this dissertation participated in the JHU ICMC model formulation, system deployment, and the study of effects of the ICMC as shown in the shaded parts of the right hand tower. Participation in model formulation involved an independent review of theoretical frameworks. It also involved cooperation with the JHU team in establishing scope and identifying key stakeholders, mapping outcomes, evidencing the outcomes and giving them value, and establishing impact. The author was not involved in system development and the coding of the ICMC software, however, cooperated with the JHU team in system deployment. This cooperation involved calculating the SROI point estimates and sensitivity analysis for costs and outcomes from the client, social direct & indirect perspectives. Finally, the

author independently studied the effects, verified, and retrofitted the ICMC with a new persona. This verification included developing a new persona, repeat of model formulation and system deployment for the new persona as well as a critique of the ICMC.

Accordingly, this dissertation contains six chapters. This first introduction chapter has briefly introduced why this work was undertaken, what background conditions suggested it as an important problem, and what this dissertation intends to accomplish.

Chapter 2 presents a review of the literature of frameworks for the evaluation of HIT systems, and delves more deeply into frameworks related to economic evaluation and, specifically, Social Return on Investment (SROI).

Chapter 3 focuses on the development of the original ICMC. The original ICMC covers six personas: A child aging out of foster care; A child aging out of childhood disabilities programs; A pregnant teen; A homeless young adult; A homeless family; and A homeless adult. The development of the original ICMC includes establishing scope and identifying key stakeholders, mapping outcomes, evidencing the outcomes and giving them value, establishing impact, calculating the SROI, and reporting. The JHU team had close internal cooperation in performing each of these steps. Evidencing the outcomes and giving them value as well as establishing impact includes a systematic literature review of costs and probabilities of providing services to each of the personas and their outcomes, which the author performed in solo.

Chapter 4 presents the results from the development of the original ICMC. These include the results from evidencing the outcomes and giving them value, establishing impact, and calculating the baseline and sensitivity analysis of the SROI. The results from calculating the baseline and sensitivity analysis of the SROI are in the form of text, tables, and graphics produced by the author through the use of the ICMC.



Chapter 5 is a verification of the original ICMC through modifying it to accommodate the last persona: A victim of domestic violence. The retrofitting of the last persona was done by the author independently and separately, and post hoc from the original six personas. The objective of retrofitting the additional persona is to test whether the original ICMC is robust enough for application to any additional persona. A review and comparison of the results and outputs of both the original ICMC and the modified ICMC, discussed in chapters 3 and 5 respectively, is also offered in Chapter 5.

Chapter 6 delivers a discussion of the results, strengths, and weaknesses of the models, as well as suggestions for how future research can improve the results of this study. A complete Bibliography, which comes after Chapter 6, presents the references.

## Chapter 2 – An approach to Social Return on Investment (SROI)

### Introduction

Despite the explosive growth of the Internet, and the early realization of the potential of HIT to improve healthcare (Institute of Medicine (IOM) Committee on Improving the Patient Record, Steen, & Dick, 1991), the expansion of IT into the healthcare and social welfare settings is fairly recent. The adoption of Health IT, in the form of systematic use of the integrated medical record and interventions to make care safer, became operational when in 2010, the Office of National Coordinator for Health IT adopted a policy of paying physicians and hospitals for “meaningful use” of certified electronic health records (EHRs). The motivation for this policy was that systematic use of the integrated medical record would make care safer and more effective (Bates & Gawande, 2003; Blumenthal & Tavenner, 2010). The process of adapting to the information revolution has been even slower in human services and most of the efforts towards building the IT infrastructure and interoperability are still in a research and development phase (Miettinen, Mykkanen, & Laaksonen, 2012; Orlova, et al., 2005).

In parallel to the research endeavors in academia, the Administration for Children and Families (ACF) has made efforts to standardize human services information exchanges through the development of the National Human Services Interoperability Architecture (NHSIA). NHSIA as the ACF defines it is:

***a framework to facilitate information sharing, improve service delivery... [and] offers a foundation for common understanding, interoperability, standards, and reuse. Objectives include establishing a common vocabulary, providing a business and technical framework, promoting sharing and reuse, encouraging data exchange standards development, developing standard data structures, and improving operational efficiency and effectiveness (Administration for Children and Families (ACF), 2014)***

In addition to NHSIA, the Centers for Medicare and Medicaid Services (CMS) is also working on an information exchange architecture named Medicaid Information Technology Architecture (MITA). Similar to NHSIA in human services, MITA, which has today become an integrated part of the Affordable Care Act, is:

***A national framework to support improved systems development and health care management for the Medicaid enterprise. MITA has a number of goals, including development of seamless and integrated systems that communicate effectively through interoperability and common standards... [MITA] is intended to foster integrated business and IT transformation across the Medicaid enterprise to improve the administration of the Medicaid program (Centers for Medicare and Medicaid Services (CMS), 2014b).***

Both the NHSIA and the MITA architectures, are based on two data exchange models:

- 1- The Federal Enterprise Architecture (FEA): CMS has used this architecture since 1999 in response to the Clinger-Cohen Act of 1996. The objective of the FEA is to “facilitate shared development of common processes and information among Federal Agencies and other government agencies (Centers for Medicare and Medicaid Services (CMS), 2014a; Morlock, Richeson, Baller, Okebukola, & Mohit, 2012; Office of Management and Budget (OMB), 2014).”
- 2- The National Information Exchange Model (NIEM): NEIM has been in use since 2005 by the U.S. Department of Homeland Security and the U.S. Department of Justice. The U.S. Department of Health and Human Services joined as the third steward of NIEM in 2010 (Morlock, et al., 2012; The National Information Exchange Model (NIEM), 2014).

These technical developments are happening while a 2006 report from the Agency for Healthcare Research and Quality (AHRQ), commending the move towards greater HIT use, highlights that there is a need for return on investment (ROI) studies of HIT in healthcare settings (Shekelle, et al., 2006). This report highlights the potential economic value of HIT in several areas:

***The main quantifiable benefits of an EHR system were savings from data capture and access; decision support to improve efficiency, quality, and safety of care; business management related to staffing, billing, and overheads; and streamlining patient flow.***

*Few studies quantitatively assessed the costs to implement an EHR system and the financial benefits reaped from it.*

*All the cost-benefit analyses of an EHR system predicted that the financial benefits would significantly outweigh the costs, in a timeframe that varied from three to thirteen years, but this evidence is limited to large organizations and multi-functional EHR systems.*

*There is some evidence regarding the positive economic value of implementing component parts of an EHR system, with models suggesting that many of the benefits do not accrue unless a broadly functional system is implemented. (Shekelle, et al., 2006)*

Thus, Shekelle's and colleagues' repeated emphasis on a single Electronic Health Record (EHR) system points to their hope that care delivery systems can benefit from such an integrated system. On the other hand, while the EHR in its current form is limited to clinical settings, its concept is not different from the concept of interoperability.

This report makes a number of recommendation that support the need for ROI studies::

*The organizational change and workflow redesign required by and accompanying HIT implementation (or implementation of a new HIT function) need to be described and measured with greater validity, reliability, and precision in order to understand the impact of HIT on care delivery. Without such information, the true "intervention" remains unclear... (Shekelle, et al., 2006)*

This study does consider the interaction of various stakeholders in a SROI study.

Furthermore, the results of this study yield several perspectives, including the client perspective, the direct social perspective, and the indirect social perspective.

*The costs and benefits of HIT depend not only on the internal system (the practice environment) but also on the interactions with the external system, including consumers (patients and potential users of the healthcare system), medical service suppliers (laboratories, radiology centers, other healthcare organizations), technology suppliers, and the regulatory and financing systems an organization operates. Multi-perspective studies are needed to investigate the flow of costs and benefits in order to maximize the benefits of HIT in the larger healthcare delivery system. Again, simulation modeling may be the best methodology for this type of research (Shekelle, et al., 2006).*

The "multi-perspective" offered through Interoperability projects of health and human services departments are an ambitious and novel effort in the field of human services IT. This

novelty combined with the complexity of the relations of the various stakeholders involved, along with few benchmarks of outcomes or methods to compare calls for innovative approaches. The first is to find theoretical frameworks, which could compare and relate the multiple personas to each other. This literature review is a reflection of the efforts made towards this end and is a review of the theoretical frameworks related to the evaluation of HIT systems.

## **Objective**

As originally presented under Goals and Specific Aims in Chapter 1, the objective of this Chapter is to fulfill the first specific aim by providing a systematic appraisal of evidence on the methods of a SROI, and to identify areas where future work needs to inform the development of evidence. The research question related to this aim is what theoretical and empirical evidence is available from previous research in the areas of modeling and the social costs and SROI of implementing information technology in the public sector for human services? This Chapter addresses this question through a snowball literature review of the current frameworks available for the proposed Social Return on Investment (SROI) modeling

## Methods

The search for theoretical frameworks was done through primary library searches, and snowballing through the search of references (Greenhalgh & Peacock, 2005). The Johns Hopkins University Sheridan Eisenhower Library, and Welch Medical Library electronic catalog, Catalyst, was searched for Social Return on Investment (SROI) models. PubMed was used to conduct ad hoc searches. PubMed is an online database accessible through the World Wide Web. It provides free access to MEDLINE, which is the National Library of Medicines (NLM) database of citations and abstracts in the fields of medicine, nursing, dentistry, veterinary medicine, health care systems, and preclinical sciences and currently references over 5,600 biomedical journals published in the United States and worldwide (National Library of Medicine (NLM), 2014).

In addition to the primary references, relevant references of the sources identified were searched in an attempt to expand the search through snowballing and citation tracking techniques. Greenhalgh & Peacock (2005) define snowballing as reference tracking and scanning the reference lists of all full text papers and choosing relevant references to pursue further. Citation tracking uses special citation tracking databases to forward track selected key papers and thereby identifies articles in mainstream journals that had subsequently cited those papers (Greenhalgh & Peacock, 2005). The Web of Science, offered through the Welch Medical Library, was used to complete citation tracking.

## Results

The search yielded 16 publications (Aqil, Lippeveld, & Hozumi, 2009; Cresswell, 2004; Cresswell, Burke, & Pardo, 2006; DeLone & McLean, 1992, 2003; Donabedian, 1966; Harrison, Koppel, & Bar-Lev, 2007; Lehmann, 2011; Lingane & Olsen, 2004; Nicholls, Lawlor, Neitzert, & Goodspeed, 2009, 2012; Nicholls, Mackenzie, & Somers, 2007; Noll, 2002; Petrou & Gray, 2011; Philips, et al., 2004; Sockolow, Crawford, & Lehmann, 2012). Of these models the Donabedian (1966) model on the quality of healthcare services, and the DeLone & McLean (1992 & 2003) model on the evaluation of IT systems, are high-level theoretical models and do not delve into operational details. Nicholls, authoring with several teams (2007, 2009, & 2012), offers a more detailed methodology for a SROI study. Lingane and Olsen (2004) offer valuable methodological nuances and insights into conducting a SROI study in a general setting, while Petrou and Gray (2011) deliver the same insights for economic evaluation using decision analytical modelling in a healthcare delivery setting. The models of Aqil et al (2009), Cresswell et al (2004, 2006), Harrison et al (2007), Lehmann (2011), and Sockolow et al (2012) were reviewed in further detail.

After the review it was found that the Stack Paradigm (Lehmann, 2011) the Prism Model (Aqil, et al., 2009) and the HITREF model (Sockolow, et al., 2012), were too broad in their scope and not operationally detailed enough to apply to this work. The socio-technical model (Harrison, et al., 2007) provided a good degree of detail, however, it is more appropriate for clinical settings as opposed to the governmental social work setting under which human services interoperability is applied. Post hoc searches found good questions proposed by the New Economic Foundation (nef) model (Nicholls, et al., 2009, 2012; Nicholls, et al., 2007), as well as the precede-proceed type framework (Green, 1974) that the nef model uses provide additional insight, However, the best level of operational detail appropriate for government projects was found in the Cresswell et al (2006) model, which is reviewed below.



## Review of the theoretical framework

### The Government IT SROI Framework (Cresswell, et al., 2006)

Cresswell and colleagues outline a framework for a SROI type of analysis based on the values created as a result of an IT project in the governmental sector (Cresswell, et al., 2006). This framework, as demonstrated in Figure 2.1, involves a series of incremental steps that illustrate how the process of value identification and measurement carries through from the goals of an IT investment, through the value generating mechanisms of the business processes, connection with stakeholders, to specific data gathering and reporting.

Based on this framework, Cresswell, et al. (2006) identify four ways in which an organizational IT program can create value (Value Mechanisms and Value Types boxes on the right hand side of Figure 2.1.).



Figure 2.1- Steps in applying the public value framework (Cresswell, et al., 2006)

The value-generating mechanisms are:

- 1- Increases in efficiency – Which is to achieve an increase in output or goal accomplishment while using the same inputs and resources, or delivering the same outputs or goals while consuming less resources.*
- 2- Increases in effectiveness – To increase the quality and/or quantity of a desirable entity.*
- 3- Enablement – To provide the means towards or allowing an otherwise infeasible or forbidden but desirable activity, or to avert or to reduce undesirable events or outcomes.*

***4- Intrinsic enhancements – To change the environment or conditions of a stakeholder in ways that is valued for their own sake (Cresswell, et al., 2006).***

In addition, like all other forms of business, organizational IT innovation is also a risky business. Cresswell, et al. (2006) list the steps to approach this risk as: ‘identify and evaluate threats; develop and evaluate response methods; and produce a summary analysis and mitigation strategy’. Cresswell, et al. (2006) argue that such risks have the potential to affect a variety of interests, most importantly the six outlined below:

- 1- Financial – impacts on current or anticipated income, asset values, liabilities, entitlements, and other aspects of wealth or risks to any of the above.***
- 2- Political – impacts on personal or corporate influence on government actions or policy, role in political affairs, or influence in political parties or prospects for current or future public office.***
- 3- Social – impacts on family or community relationships, social mobility, status, and identity.***
- 4- Strategic – impacts on economic or political advantage or opportunities, goals, and resources for innovation or planning.***
- 5- Ideological – impacts on beliefs, moral or ethical commitments, alignment of government actions or policies or social outcomes with beliefs, or moral or ethical positions.***
- 6- Stewardship – impacts on the public’s view of government officials as faithful stewards or guardians of the value of the government itself in terms of public trust, integrity, and legitimacy (Cresswell, et al., 2006).***

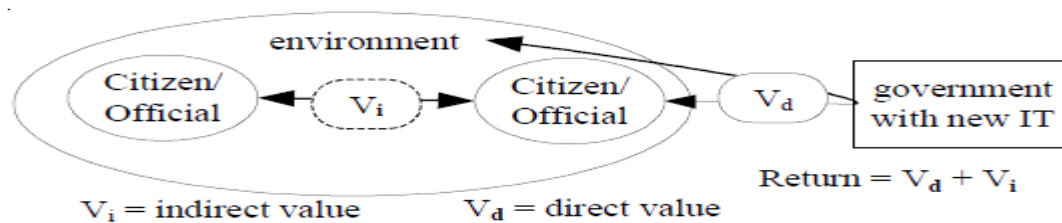
Furthermore, for any type of IT project the sources of risk can be grouped under two major headings:

- 1) Development risk: Development risk, simply put, is risk that the development and implementation of the IT will fail outright or will not perform as designed and intended.***
- 2) Benefit risk: Benefit risk applies to whether the IT investment will fail to produce the envisioned benefits in spite of being successfully developed and implemented (Cresswell, et al., 2006).***

When the above four values (Increases in efficiency, Increases in effectiveness, Enablement, Intrinsic enhancements) are studied in parallel with the previously discussed six threats to public return (Financial, Political, Social, Strategic, Ideological, Stewardship), the net value potential that IT

solutions can offer to address the risks of their implementation becomes clear. The authors note that:

*“The financial value [of an IT system] results from lowering the cost or increasing the efficiency of government [or organization] or delivering direct financial benefits to the citizens [or stakeholders]. Political value consists of increasing participation, fairness, transparency, legitimacy, or conferring political capital to elected officials or citizens. Social returns include increased social status, stronger relationships, or opportunities; increased safety, trust in government, and economic advantage (Cresswell, et al., 2006).”*



**Figure 2.2- The Mixed Direct, Indirect Service and Environment model (Cresswell, et al., 2006)**

In order to calculate the ‘financial value’ of each of these types of returns, Creswell and colleagues (2006) propose the Direct Service (Type 1), Indirect Service (Type 2), and Mixed Direct, Indirect Service and Environment (Type 3) impact type models as shown in Figure 2.2.

Another element that Creswell and colleagues (2006) focus on is the issue of stakeholders as shown on the right hand side of Figure 2.1. They identify stakeholders broadly as “those with an interest in the value generating process” and emphasize that although stakeholder analysis is ultimately context-dependent, and thus includes no standard processes to follow, however, “there are consistencies among the many versions of stakeholder analysis methods found in the management, planning, and assessment literature.” They identify three main parts required for this kind of stakeholder analysis:

1. *identifying the persons or groups (including organizations) whose interests are potentially affected*
2. *identifying what their specific interests may be, and*
3. *assessing their role and potential influence in the delivery of public value (Cresswell, et al., 2006).*

and recommend a broad approach for finding stakeholders, which includes:

- *Involving multiple participants with wide knowledge of the stakeholder environment*
- *Looking widely to identify all relevant stakeholders through brainstorming and related methods to stimulate divergent thinking and include multiple opinions and information sources*
- *Identifying multiple stakeholder roles, internal and external to the organization setting (e.g., internal user, customer, vendor, developer, manager, oversight, politician, taxpayer, analyst, advocate, etc.)*
- *Identifying stakeholder expectations, influence potential, past and future participation possibilities, and level of interest (Cresswell, et al., 2006).*

By combining the stakeholders and the proposed values that are important to each group of them, Cresswell, et al. (2006) create the Stakeholder Value Matrix, as demonstrated in Table 2.1. In this matrix the columns are the stakeholders, the rows are the business processes in which value is being created, and the cells are the values that are important to a stakeholder.

In the same way that stakeholder analysis is context dependent, the values for stakeholders are also context dependent and should be modified according to the nature of the project. The authors note that the matrix, displayed in Table 2.1, should “be thought as a heuristic device, prompting questions about what might be useful and available variables for each row and column (Cresswell, et al., 2006).” They emphasize, “Identifying a specific variable relies on combining information about stakeholder interests, the value type, the impact mechanisms, and the context (Cresswell, et al., 2006).”

Table 2.1- Stakeholder Value Matrix(Cresswell, et al., 2006)

Business Process	Value Generator	Impact Type	Stakeholders		
			Citizens at Large	Vendors	Elected Officials
Budget for procurement	Intrinsic	3	stewardship		
Determine needs	Intrinsic, effectiveness	3	ideology, stewardship		political, strategic
Qualify vendors	efficiency, intrinsic	1,3	ideology, stewardship	financial, strategic	political, strategic
Conduct auction	efficiency, intrinsic, effectiveness	1,3	ideology, stewardship	financial, strategic	political, strategic, stewardship
Pay vendors	efficiency, intrinsic	1,3	stewardship	financial, strategic	political, stewardship

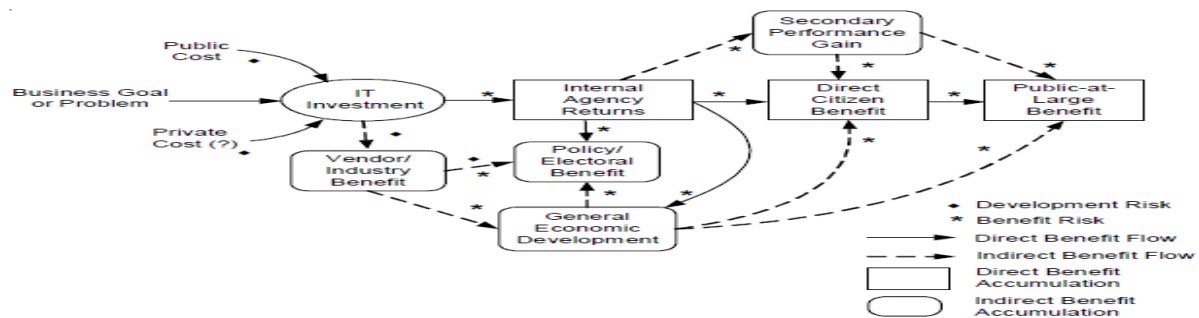
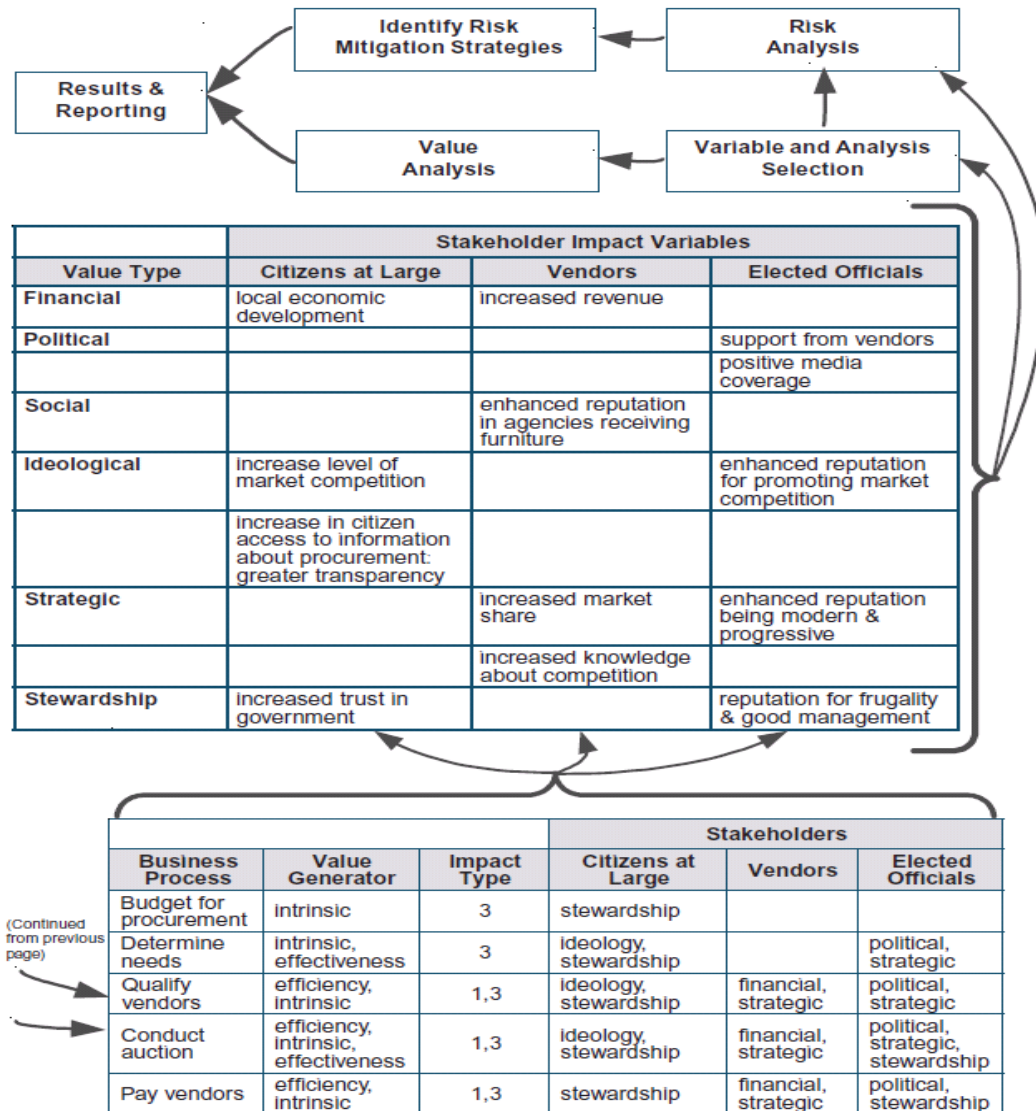


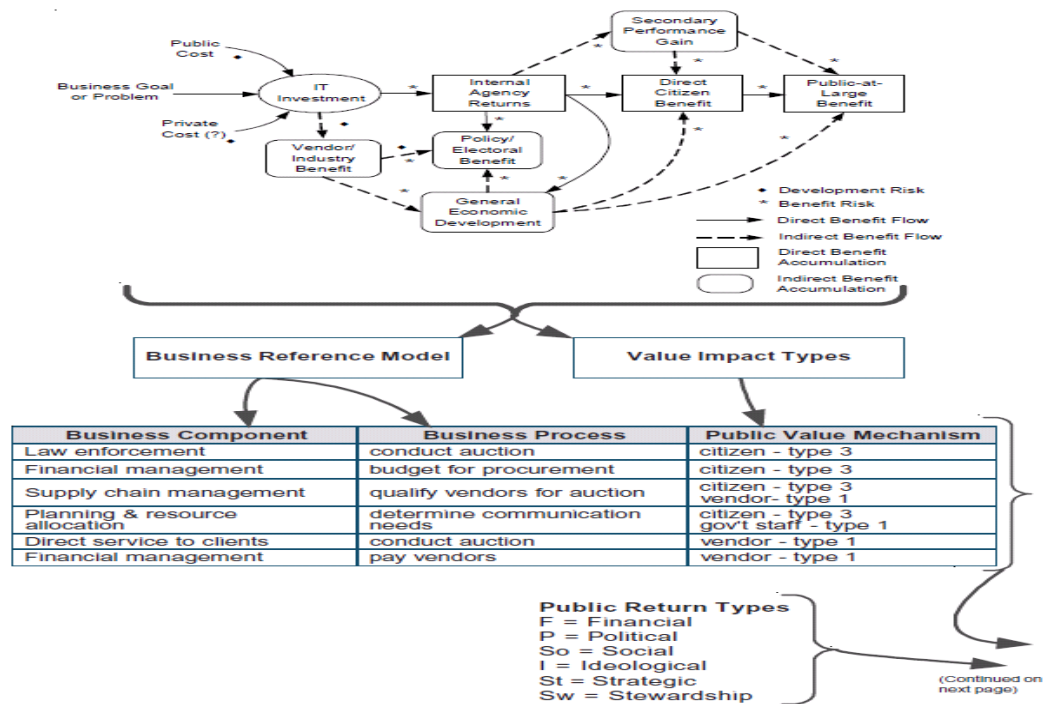
Figure 2.3- Public Return on Investment Value Chain (Cresswell, et al., 2006)

This review of conceptual frameworks leads to the conclusion that capturing the values of alternatives in an IT business decision is an important and crucial step in a SROI analysis. Discovering and defining variables to represent these values requires not only the available literature on the subject but also accounting for unavailable formal data, and consensus building in capturing the legitimate concerns of all stakeholder groups. Once these data become available, they can be used to expand the impact models illustrated in Figure 2.2, to create Figure 2.3. Figure 2.4 demonstrates the incremental steps involved from laying out the right hand side of Figure 2.1 to completion of Table 2.1.



**Figure 2.4- The Public Value Framework Overview (I)**

Figure 2.5, which is a continuation of Figure 2.4, extracts the Business Reference Model and the Value Impact Types from Figure 2.4, and utilizes them to build the left hand side and to complete Figure 2.3.



**Figure 2.5- The Public Value Framework Overview (II)(Cresswell, et al., 2006)**

In summary, the Cresswell et al. (2006) Government IT SROI Framework initially takes four benefits (efficiency, effectiveness, enablement, and intrinsic enhancement) and deducts the six risks (financial, political, ideological, strategic, and stewardship) via the direct, indirect, or mixed models shown in Figure 2.2. It then takes a qualitative approach to involve the stakeholders via Table 2.1, and the direct value chain shown in Figure 2.3. It then combines Figure 2.2 and Figure 2.3 to create Figure 2.5. Figure 2.4 shows how the original Figure 2.1 is created from Figure 2.5 and Table 2.1.

## Conclusion

Of the models reviewed in this chapter, the Cresswell et al (2006) Government IT SROI Framework is fundamental to development of the ICMC. Their model is chosen to drive this work, due to an understanding it delivers of the mechanisms under which interoperability could generate value. The special attention for mechanisms that could lead to increases in efficiency, effectiveness, enablement, as well as intrinsic enhancements driven by interoperability was a direct result of the use of the this model. Furthermore, the Government IT SROI Framework by Cresswell et al (2006), introduced three necessary perspectives for a SROI model to be complete which includes the direct, indirect and client value chains. The ICMC uses these perspectives in the form of social direct, and social indirect perspectives. The ICMC also takes advantage of the emphasis the Creswell et al (2006) Government IT SROI Framework gives to engage stakeholders. This engagement directive is utilized fully as most of the data that feeds into the ICMC comes directly through discussions with health and human services department managers and social workers.

In Chapter 3, the discussion will focus on the methodology in which the Government IT SROI Framework is used to develop the original ICMC. This discussion will include the assumptions behind the ICMC, the methods used to collect the data fed into the ICMC, as well as the underlying mathematical and statistical methodology that empowers the ICMC.



## **Chapter 3 – Social Return on Investment (SROI) Model Development for the original Intensive Case Management Calculator (ICMC)**

### **Background**

Interoperability of human services, in the form of electronic data sharing coordination among service providers, has demonstrated to be cost effective when implemented in metropolitan areas with large populations, such as the New York, NY. In New York, NY, city officials estimated that for every dollar invested in health IT, a savings of \$41 would be realized (NYC Health, 2008). Recent efforts towards interoperability and integrated health and human services delivery systems under the Live Well program in San Diego, CA. have also improved the top 10 living indicators, even though these improvements have not been monetized (San Diego County, 2014). While the officials at the Administration of Children and Families (ACF) are optimistic about the results of these experiments with interoperability, they also have had questions about the generalizability of interoperability savings in smaller jurisdictions (Administration for Children and Families (ACF), 2013). Specifically, ACF raises the main question related to the affordability of interoperable systems in rural or even smaller urban jurisdictions: Given the high investment costs of interoperability, are the savings limited to areas with a dense urban population, or can smaller jurisdictions with more scattered population densities also experience these savings? In order to fill the knowledge gap that existed in this area, the ACF issued research grants to several county health and human services departments to experiment and study different aspects of interoperability. The ICMC is designed to help health and human-services department managers understand the financial cost and benefits, as well as the statistical risks, they face when they decide to invest in interoperability.

This chapter is a description of the qualitative and quantitative methods used in the development of the ICMC. It first reviews the differences between As-Is and To-Be (the eICM) models of care delivery. It then reprises the Government Health IT framework that the ICMC project used to build the eICM SROI model and continues with a description of the components of that model.

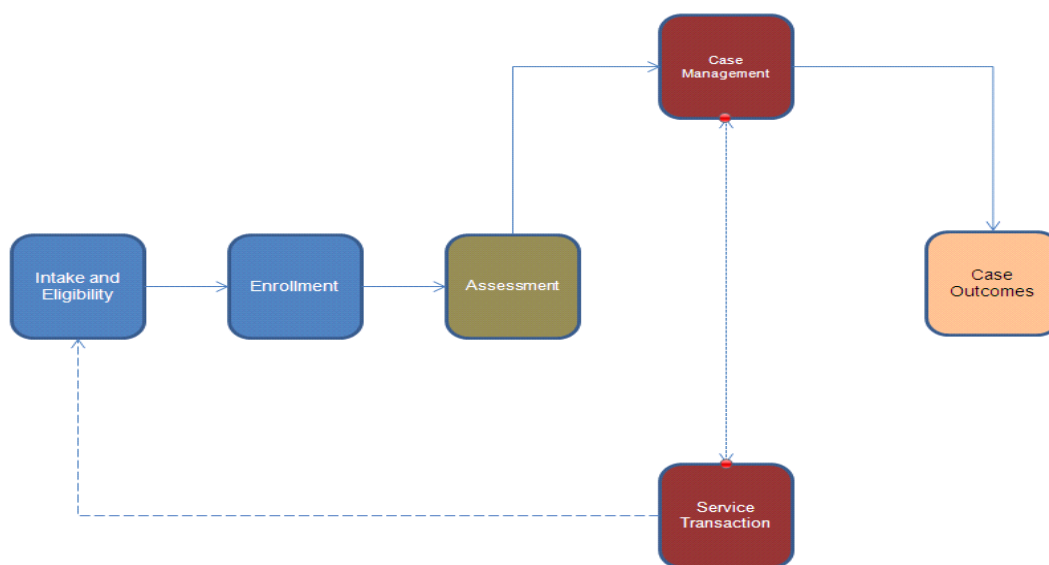
## Objective

As presented under Goals and Specific Aims in Chapter 1, this Chapter aims to fulfill the second and third specific aims. The second specific aim is to investigate the business model of care delivery for six elicited personas and to understand the changes induced by interoperability on the business model. The research question related to this aim is what is the estimate of the overall impact of an interoperability strategy on a local health and human services department in terms of service delivery, efficiency, and outcomes? This Chapter addresses this question through eliciting a workflow map, resource utilization, and presumed outcomes under the As Is (pre interoperability) and To Be (post interoperability) conditions.

The third specific aim is to articulate the cost model of care delivery for six elicited personas and to understand the changes induced by interoperability on the cost model. The research question related to this aim is how would the overall monetary impact vary under different configurations for the interoperability strategy? This instantiates the SROI model with costs and probabilities collected from interviews, systematic literature review, and administrative data. It also incorporates the elicited data into a computer-based SROI model, embedded in the ICMC.

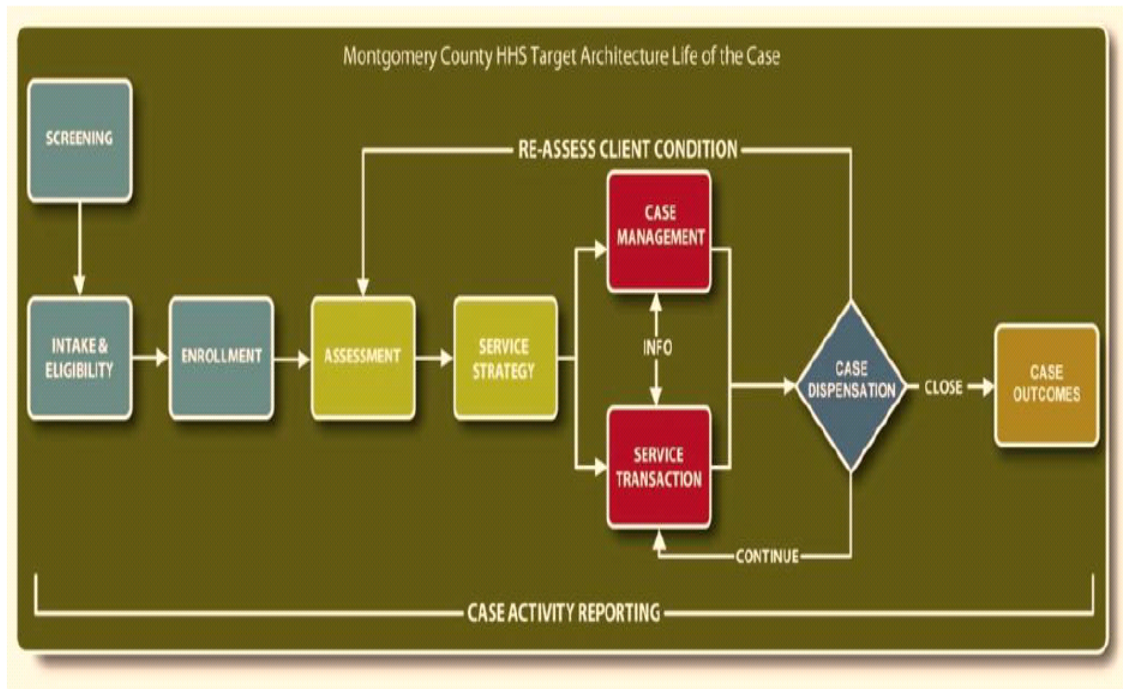
## Conceptual framework (As-Is vs To-Be: The eICM framework)

The basis of the eICM is the “Life of a Case” workflow model designed specifically for health and human-service operations as displayed in Figure 3.2 (Maryland DHR, 2012). Under this idealized model, a client arriving to receive services from the DHHS encounters a DHHS that is working under a non-interoperable model (As Is – as displayed in Figure 3.1), or has completed the implementation of interoperability (To Be – as displayed in Figure 3.2).



**Figure 3.1- As Is service delivery model of DHHS**

Under As Is, as demonstrated in Figure 3.1, the client enters the department with a specific request through intake. At this stage, the client’s data are collected, and eligibility for services is determined. If the client is eligible, s/he enrolls in a specific service, and after assessment goes through case management. The DHHS then dismisses the client with either little to no follow-up for determining the outcomes, or occasionally may refer a client to another program through service transaction, in which the cycle restarts, with a redundant, intake and eligibility, and enrollment stages.



**Figure 3.2- The "Life of the Case" Workflow Analysis Model (Maryland DHR, 2012)**

However, as Figure 3.2 displays, a new client's relationship with the DHHS under the idealized state of To Be should begin with intake. The intake stage encompasses the screening, intake and eligibility, and enrollment stages. After this first stage, the client goes through triage through primary assessment and the development of a relevant service strategy. Under the Intensive Teaming Protocol (ITP), though a team may deliver services to a client, a single social worker coordinates this triage during referrals in the next service delivery stages. The service delivery stage that follows includes case management and transition through the various services after which the case may be closed, or in the case of need, redirected to triage for a new assessment or service delivery through service transition. After the DHHS completes and closes the case treatment, it follows up with the client for a period for the purpose of outcomes assessment.

Thus, major differences between As-Is and To-Be (eICM) are the lack of screening and service strategy and case dispensation and follow up, and redundancy of intake and eligibility and enrollment under As Is. These add up to create a weak and non-systematic connection between

service transaction and the new cycle of intakes under the As Is system. The objective of the ICMC is to quantify and monetize these weaknesses using a SROI framework.

## **Proposed theoretical model for calculating SROI**

The Cresswell et al (2006) Government Health IT SROI framework, as displayed in Figure 2.1, guides the design of the stages of this study. These stages in sequential order include:

1- Establishing scope and identifying key stakeholders

2- Mapping outcomes

3- Evidencing the outcomes and giving them value

4- Establishing impact:

- Assigning cost values to services and outcomes

- Assigning probabilities to probabilistic values

5- Calculating the SROI:

- Running the ICMC calculator and obtaining point estimates for the costs and outcomes from the client, social direct, and social indirect perspectives

- Running the ICMC calculator and obtaining sensitivity analysis results from the client, social direct, and social indirect perspectives

6- Reporting, using, and embedding.

This analysis is an extension of a cost-effectiveness analysis that makes the gains and tradeoffs of program-level outcomes against costs and outlays explicit (Cresswell, 2004; Cresswell, et al., 2006). The use of the SROI methodology takes place through a series of qualitative and quantitative steps. The qualitative portion includes interviews with program managers, project directors, and caseworkers, but not the clients. Chapter 6 delivers a discussion on selection of the interviewees. The quantitative steps attempts to integrate data from interviews, a Return on Taxpayer Investment (ROTI) study (developed in parallel and in close coordination with this study by Accenture Consulting), as well as literature searches through the use of a decision tree model.

## **Assumptions of the ICMC SROI model**

The modeling process is guided by nine principal assumptions that are referenced in analytic decision support models for health technology assessments (Philips, et al., 2004). Before discussing the steps recommended by Cresswell et al (2006) Government Health IT SROI framework, this set of nine assumptions are listed:

### **a) Setting**

As a way to site the study in the reality of providing health and human services, the selected specific setting is The Montgomery County Department of Health and Human Services (MC DHHS). The numbers reported are from the ranges elicited from the County. However, out of concern for the MC DHHS's confidentiality, specific estimates are not necessarily those provided by the Department.

MC DHHS is one of the few local health and human services department within the state of Maryland, and is responsible for public health and human services that help address the needs of over one million residents and the community's most vulnerable children, adults, and seniors. Historically, the 1995 merger of four Montgomery County departments including the Department of Addiction, Victims and Mental Health Services, the Department of Family Resources, the Department of Social Services, and the Health Department resulted in the formation of the MC DHHS. The MC DHHS fiscal year 2013 Budget is \$252,303,162; it employs 1558 people; offers 124 unique programs to a client base of 85,500 clients served per year in 23 service delivery locations (excluding schools); and holds 500 delivery contracts with service partners (Montgomery County, 2013).

Today, the core services MC DHHS provides protect the community's health, guard the health and safety of at-risk children and vulnerable adults, and address basic human needs including



food, shelter, and clothing. These services are delivered through several service areas, which include: Aging and Disability Services; Behavioral Health and Crisis Services; Children, Youth and Family Services; Public Health Services and Special Needs Housing. The Office of Community Affairs provides direct outreach services through several programs. Administrative divisions operate to insure the coordinated and continuous function of all divisions of the MC DHHS. The common administrative functions include budget administration, fiscal administration, contract management, facilities, grant acquisition, human resources, information systems, and performance management. Figure 3.3 displays the organizational relationships within MC DHHS.

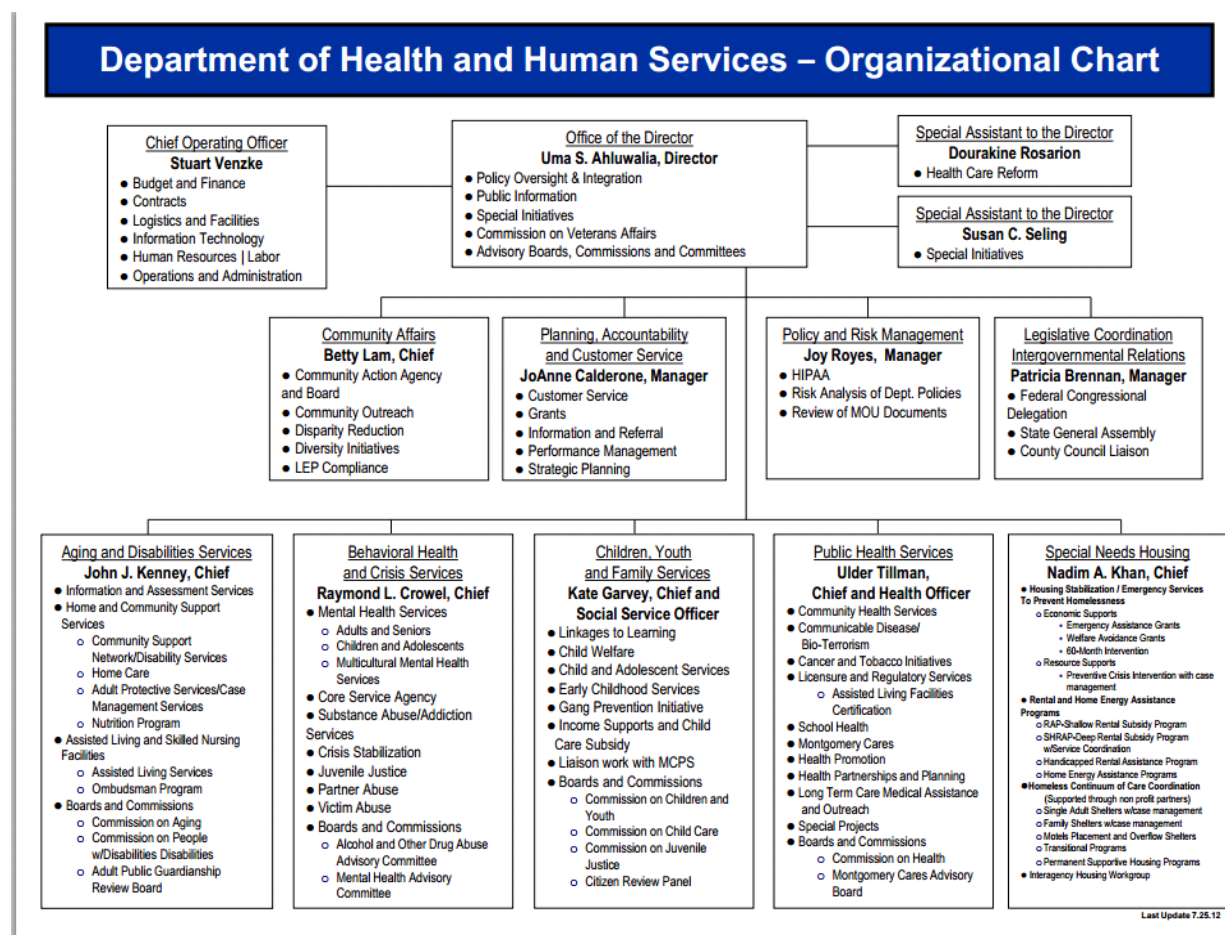


Figure 3.3- Montgomery County DHHS Organizational Chart

## b) Target Population for the SROI model

The target population for the interoperability project is all clients of MC DHHS. However, the focus of the ICMC is on the “tip of the service iceberg”, or the clients with maximal needs. The reasoning for this is that it is expected that the eICM data sharing would generate the most value on just those clients requiring services, from the most varied service areas. If the ICMC could not confirm that value, then either the ICMC model is wrong or these clients are too far advanced in their needs to benefit from eICM. In the former case, the ICMC would be reviewed. In the latter case, the suggestion would be to target clients earlier in their downward spiral.

**Table 3.1- Summary of MC DHHS client personas\***

<b>Client group represented</b>	<b>Persona Summary</b>
Children aging out of foster care	17 years old, mental health, physical disabilities, developmental disabilities, reside in foster care home
Pregnant teens	16 years old, in high school, failing in school, 1st child, single parent, previous trauma (sexual abuse), highly dysfunctional family, housing is tenuous
Children aging out of children's disabilities programs (who are not in foster care)	19 years old, developmental disabilities, physical disabilities, mental health, in a residential program
Homeless young adults	21 years old, co-occurring diagnosis (mental illness + substance abuse), behavioral issues
Homeless Families	21-year-old single mother with multiple children, no access to housing, no income, mental health diagnosis (eligible for public mental health system)
Homeless Adult	45 years old, mental health illness, physical disability, substance abuse
*The selection of the personas was suggested by the leadership of MC DHHS	

The “sample” then of the ICMC is a collection of six personas, which represent those extreme-need clients. A single persona is the narrated story of a fictitious client, which represents the mode of all clients within the client group under study (Valaitis, et al., 2014). Table 3.1 summarizes these six personas, and subsequent sections discuss them in further depth. A point of emphasis is the personas represented in Table 3.1 are the ones suggested by MC DHHS leadership to be their clients with maximal needs, and other jurisdictions may have a different persona set.

### **c) Alternatives**

Since the SROI model uses the framework of a cost-effectiveness model, there must be alternation actions or options that the decision maker can take. The alternative strategies are As Is and To Be. The As Is alternative is that MC DHHS continues its operations with its programs arranged in a silo fashion with very little to no interaction, under the service delivery model that Figure 3.1 displays. The To Be alternative is an imagined future state in which MC DHHS has implemented interoperability, with a service delivery model Figure 3.2 demonstrates. In reality, however, any jurisdiction may follow partial implementation of interoperability, and their SROI estimates will fall in between the estimates the ICMC provides for As Is and To Be. In order to provide a bounding of the best and worst case, the extreme cases are used.

### **d) Outcomes**

The interviews for this project revealed that the MC DHHS leadership defines the goals of providing services are to improve the client’s (and first degree relatives) status of housing, education, employment, access to healthcare and permanent connections, which are collectively abbreviated as HEEAP. Table 3.2 provides the working definition MC DHHS uses for these outcomes.

**Table 3.2- MC DHHS Outcomes defined\***

<b>Variable</b>	<b>Definition</b>
Housing	Prevent homelessness from occurring or make it as short term as possible.
Education	Obtain sufficient education and training to become employable and retain steady employment.
Employment	Obtain right job skills to gain employment and stay employed. Generate sufficient income to support household.
Access to Health Care	Gain access to health care that includes physical, mental health and emergencies.
Permanent Connection	Connect to at least one supportive and caring person who is engaged, and can help with the achievement of life goals.
* The working definitions of outcomes was provided by MC DHHS leadership	

#### **e) Uncertainties and Probabilities**

The key parameter that reflects the effectiveness of either As-Is or To-Be, is the binary probabilistic variable of Spiral Up/ Spiral Down. This variable is defined in response to the question: Does the packet of services delivered by MC DHHS to the client persona lead to an overall improvement of the client's living conditions (Spiral Up), or does the client continue on the same life conditions, which led him/her to seek welfare services in the first place (Spiral Down)? Spiraling Up or Down are then further defined in terms of the HEEAP parameters. It should be considered that the Spiral Up and Spiral Down are extreme cases considered for modeling purposes. To understand the full range of possible outcomes, intermediate outcomes of stabilization may occur. The extreme cases are considered to provide a bounding of the best and worst case.

#### **f) Perspectives**

A SROI analysis needs to consider the perspectives of multiple stakeholders, with the hope that their sum will be representative of the entire society (Cresswell, 2004; Cresswell, et al., 2006).

As Figure 2.2 displays, the Government IT SROI Framework by Creswell et al (2006) delineates two types of direct and indirect values generated. It then goes on to add values generated from each of the three perspectives together to produce the total social perspective as Figure 2.2 displays in the bottom right hand side.

Similarly, this study considers the Client, Social Direct, and Social Indirect perspectives. The Client perspective is implemented by the values the client experiences, mostly as a result of increased income. The Social Direct perspective considers the values the government agencies sustain (expense or savings), which are generally expressed as cost avoidance from not having to provide services that may have been necessary. The Social Indirect perspective realizes the values that stakeholders other than the client or government experience from direct or indirect contact with the target client.

#### **g) Time horizon**

Given that the average current life span (depreciation time) of governmental IT renovation investments is five years, this study uses this time horizon. The model assumes that the interoperable system will take one year to implement and after implementation will have four years to deliver benefits. The model thus “follows” an individual client for 5 years, and assesses the outcomes generated over that time period, as a result of the investment made in that first year.

#### **h) Structure**

Because in this exercise of modeling there are neither recurring parameters (the investment in interoperability occurs only once), nor interactions between alternatives (As Is and To Be are mutually exclusive), a decision tree (Stahl, 2008) is the appropriate structure for this SROI model.

Figure 3.4 presents the decision tree utilized in this study. The components of the generic decision tree are as follows:

- “(i) the decision node, the formal representation of the moment in time when a decision maker makes a choice between competing strategies;*
- (ii) the decision strategy, a specific strategy set or programme of actions or events consequent to a decision (in simple decision trees, this is incorporated as a series of chance nodes and/or Boolean nodes representing the resulting specific events consequent to making a given strategic choice);*
- (iii) the outcome nodes, the terminal branches of the tree that represent the value of the outcomes of the strategy.” (Stahl, 2008)*

Figure 3.4 represents the decision nodes referenced by Stahl (2008) as a square (which reflect the decision to invest in 'To Be or to stay in As Is) and the circles represent probability (Boolean) nodes of the various conditions that can occur under As Is and To Be. Under this model, within a year of beginning implementation, a client can enter either a DHHS that has interoperability ('To Be), or one that has not yet implemented interoperability (As Is). In either case, if eligible, the client will receive a bundle of services. This bundle may lead the client to Spiral Up towards a better life or Spiral Down towards life problems that are even more complicated. For each one of the four conditions (Spiral Up | As Is), (Spiral Down | As Is), (Spiral Up | 'To Be), and (Spiral Down | 'To Be), the overall value of that condition is determined by adding the values of the five HEEAP outcomes.

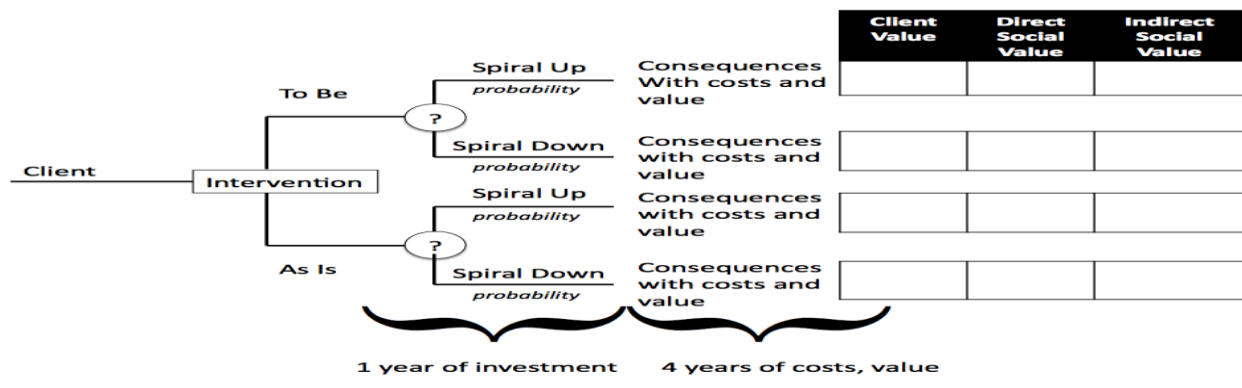


Figure 3.4- The decision tree model for calculating the value of interoperability

## **i) Desires and Tradeoffs**

This model assumes that the DHHS leadership is a unified, rational, and independent decision making body. It also assumes that the basis of the leadership decision to consider interoperability is the balance between the future benefit of interoperability and the current expenses needed to implement it. The core tradeoff faced by DHHS leadership is between social or health effects versus costs, and “desire” is expressed two ways: First, in terms cost–benefit: When benefits are expressed as dollars, is the difference between benefits and costs greater than zero? Lower costs than benefits would suggest that the investment was “worth” it..

Second, in terms of cost–consequence: How much is the investment in To Be expected to cost for each client “saved” from a Spiral Down fate, beyond the number that would be “saved” in the As Is alternative. A cost–consequence of less than a Willingness to Pay (WTP) threshold suggests that the costs are “worth” the benefit.

The concept of Willingness to Pay (WTP) is well recognized in the field of health economics. Maximum Willingness to Pay (MWTP) is commonly defined as the maximum monetary amount an individual is willing to sacrifice to obtain a good or avoid something undesirable. The method to set a maximum WTP is fraught with difficulty in economics (Kahneman, Knetsch, & Thaler, 1990). MWTP is even more difficult in health economics, especially when vulnerable and low-income populations are involved (Shillcutt, Walker, Goodman, & Mills, 2009). One heuristic first introduced by the World Bank (World Bank, 1993) and later gained wide acceptance among health economics circles is to use twice the Gross National Income (GNI) as the MWTP (Garber & Phelps, 1997). Shillcutt and colleagues (2009) comment on this approach to defining WTP:

***We argue that by defining a person's life according to the monetary value they produce or receive for their contribution to society, a human capital approach is implied.***

*Besides the theoretical foundation of twice per capita GNI, a positive economic argument exists for using a human capital approach – it is consistent with accepted practice for economic evaluation in several high-income countries. The \$US50,000 per QALY (year 1982 values) threshold commonly used in the US is similar to GNI (\$US46,040);[64-66] if \$US50,000 is inflated to year 2008 values, it becomes roughly twice per capita GNI (\$US101,295 per QALY)...*

*Defining  $\lambda$  according to economic activity of individuals is gaining recognition in economic evaluations of LMIC healthcare. The Commission for Macroeconomics and Health applied per capita income[44] and the WHO-CHOICE initiative applied GDP[18] as their thresholds for ‘very cost-effective’, and three times this level for ‘cost-effective’. (Shillcutt, et al., 2009).*

Based on the WHO-CHOICE assumption of three times the GDP per Quality Adjusted Life Year (QALY), and assuming that the value of a “social life” saved is equal to the value of QALY, this study has set the Willingness to Pay at \$100,000 per improved client. When applied to other settings, users of the SROI model and the ICMC can adjust this value so that it balances and fits the needs of clients and the limitations of healthcare decision makers. Chapter 6 provides a more complete discussion of the assumption that the value of “social life” saved is equal to the value of Quality Adjusted Life Year (QALY).



## **Protection of human subjects**

Before collecting MC DHSS data, the JHU team applied for and obtained the approval of the Johns Hopkins Bloomberg School of Public Health (JHSPH) Institutional Review Board (IRB) (see Appendix). Even though the JHSPH IRB deemed this study as non-human-subjects research, it was natural for the MC DHHS staff participating in this study to have concerns about the consequences of their participation and confidentiality of their personal information. Keeping these concerns in mind, the JHU team designed and strictly abided by the following protocol when initiating contact with MC DHHS staff:

1- Montgomery County DHHS study coordinator sends introduction email to DHHS informed staff member.

2- The JHU team sends a follow up email to the staff member with the informed consent script explaining the costs and the benefits of the study and asks for the consent of the staff member. If the MC DHHS staff consents, the JHU team will schedule an interview time. If the staff does not consent the JHU study team will ask the supervisor for an alternative staff member.

3- The JHU team conducts the interviews and names for the next round are collected.

The JHU team informed the staff that their participation is voluntary and that they are able to withdraw from the study at any time without repercussions. The JHU team also informed the staff of the study's purpose - to study the cost and consequences of the implementation of interoperability and of the potential benefits of the study, namely that the study might be to the financial benefit of the MC DHHS, and would inform management regarding how to overcome barriers in order to facilitate the staff workflow. The JHU team also assured the staff that their participation or non-participation would not affect their employment or the reviews of their work performance. Although other studies may offer tokens or payment for participation, this study did not pay for participation and the study team informed the staff of this decision.

The study did not restrict the participant's right or ability to withdraw from the study and/or seek employment elsewhere. The study team assured participants that maintaining confidentiality was a priority. At the data collection stage, the JHU team only collected the name and family name of each participant. All members of the JHU study team working on the project were not only required to have prior training in the ethical concerns of human subjects research, but were also reminded by the principal investigator of the principles of informed consent and benevolence prior to each MC DHHS meeting. From the initiation of the study, the JHU team has maintained related study data in secured rooms and drawers, and virtually in inline or online password protected mediums. The publication of the results of this study will not include any individual identifiers without additional written consent from the identified participants.

## Methods

As highlighted in the proposed theoretical model section, The Government IT SROI Framework (Cresswell, et al., 2006) model guides the stages of the development of the ICMC. This section provides the detailed methodology of each of the stages.

### 1. Scope and Stakeholders

Structured interviews using personas were employed with the objective to elicit buy-in, and to understand qualitative concerns, and quantitative estimates. Public health practitioners use persona-based scenario exercises in addition to the traditional strategies of focus groups or interviews. While the use of persona-based scenario exercises originated from the field of human computer interface design (Idoughi, Seffah, & Kolski, 2012), today they are also used as teaching and research tools in medicine (Valaitis, et al., 2014) as well as human services (Jarrott, 2012). In the context of this project, coordination with senior county officials, based on their expert opinion of the clients they serve, led to the development of the personas. The meetings focused on the question that given the persona at hand, at the current stage how would the division that the managers supervised serve a particular persona.

The meetings with the service area managers resulted in validating and confirming the personas described in Table 3.1 as the target population, and expanding to include the Spiral Up and Spiral Down conditions of the personas as displayed in Table 3.3. The officials revealed whether MC DHHS provides the services in house or outsources to contractors. The meetings also informed where the JHU team could find micro financial data on the costs of service provision.

**Table 3.3- Spiral Up and Spiral Down conditions of personas\***

<b>Client group represented</b>	<b>Persona Summary</b>	<b>Spiral Up</b>	<b>Spiral Down</b>
Children aging out of foster care	17 years old, mental health, physical disabilities, developmental disabilities, reside in foster care home	Supported Housing Working minimum wage In maintenance healthcare	Homeless or in a residential institution Unemployed
Pregnant teens	16 years old, in high school, failing in school, 1st child, single parent, previous trauma (sexual abuse), highly dysfunctional family, housing is tenuous	Supported housing Completes high school or GED Works and has child support Mental health continued support Low likelihood of second infant	Homeless Unemployed Liable to lose child(ren) to foster care
Children aging out of children's disabilities programs (who are not in foster care)	19 years old, developmental disabilities, physical disabilities, mental health, in a residential program	Supported housing Working minimum wage Has health insurance In maintenance healthcare	Homeless or in a residential institution Unemployed
Homeless young adults	21 years old, co-occurring diagnosis (mental illness + substance abuse), behavioral issues	Placement in shelter and receive proper medical treatment	Homeless
Homeless Families	21-year-old single mother with multiple children, no access to housing, no income, mental health diagnosis (eligible for public mental health system)	Housed Is receiving maintenance mental healthcare No children in foster care	Homeless High likelihood of child(ren) in foster care
Homeless Adult	45 years old, mental health illness, physical disability, substance abuse	Housed Employed Substance abuse treated	Homeless

## **2. Mapping outcomes**

For this stage, the JHU team met with consultants from Five Points. Five Points is a business consulting agency, which MC DHHS leadership had hired to comprehensively map the service delivery functions of MC DHHS. The objective of this meeting was to further develop and confirm the process maps developed in the meeting with the service area managers. During this meeting, it became clear that the Five Points consultants had made extensive progress of mapping the MC DHHS service processes for several of the service areas. A comparison of their maps revealed that the current service delivery model in most of MC DHHS divisions follows a silo model as depicted in Figure 3.1.

More importantly, the difference between the As Is condition displayed in Figure 3.1 and ideal To Be condition depicted in Figure 3.2 became clear during the meeting with Five Points. The comparison between the two figures revealed the deficiencies in the As Is model due to repeated screening, intake and eligibility, the lack of coordinated service strategy, as well as no follow up due to the lack of case dispensing. Furthermore, this meeting quantified the time difference between As Is and To Be. These differences are presented in the results section.

## **3. Evidencing the outcomes and giving them value**

The data for the ICMC came from three major sources:

- 1- From interviews and administrative data collected from MC DHHS managers, supervisors, and caseworkers.
- 2- From a Return on Taxpayer Investment (ROTI) model developed by Accenture consultants
- 3- From systematic literature reviews.

Interviews with caseworkers and supervisors did not focus entirely on one persona but instead the focus was on all the personas that received services from the division. These interviews

resulted in a complete list of services that each persona receives. Furthermore, the teams collected micro financial, epidemiological data, related to the costs of each service, the number of people who fit the persona, and the number of people MC DHHS serves per year under the current As Is conditions.

The results of these interviews were summarized in Tables for each persona. For example, Table 3.4 demonstrates the various services areas that the JHU team determined the homeless family persona might be eligible for, and currently receives services.

**Table 3.4- Services, and micro services for a homeless family persona**

Micro Service					Service	
Child Care Subsidies State Child Care Subsidy Program	HRAP - Handicapped Rental Assistance Program	Child and Adolescent In-Home BHS/ Clinic	Food Stamps	Homeless Services Program	Outpatient Addiction & Mental Health Services	Rapid Rehousing service
Montgomery Cares	Working Parents Assistance (WPA)	Community MA	Linkages to Learning	Crisis Center	Access to Behavioral Health Services	Foster Care Early Childhood Services - Infant and Toddler program
IOP OMHC	SEU	HIP - Housing Initiative Program	Kennedy Cluster Project	RAP – County Rental Assistance Program	Green Tree Family Shelter	Arbor job training assistance
SASCA (Screening & Assessment Services for Children and Adolescents )	Homeless Health Services (subset of Montgomery Cares)	Temporary Cash Assistance/ Employment Services	Housing Stabilization / Emergency Services (HS)	School Based Health/ Wellness Centers	Helping Hands Family Shelter	Montgomery Works Job readiness workshops
MA-Long Term Care	Community Case Management Team	VASAP	Medical Assistance	TESS	Stepping Stones Family Shelter	

Table 3.5 demonstrates the combination of the fiscal and epidemiological data collected by the JHU and Accenture teams, and used by both teams for the SROI and the ROTI studies respectively. Table 3.5 is an example of methods of data collection and does not intend to reveal raw numerical dollar amounts due to respect and deference for the privacy of contractual agreements.

By the end of this stage of the work, the quantification of the As Is situation of all six personas was complete. However, establishing the impact of interoperability and quantification of the To Be state remained.

**Table 3.5- Return on Taxpayer Investment (ROTI) worksheet (Accenture)\***

Issue	Agency	Program	Service	Service Administration	Direct Costs	Indirect Costs	County - DHHS	County - ALL	State	Federal	Total Expenditure	Total # of People Served	Total Cost Per Person	County - ALL - Cost Per Person	County - DHHS - Cost Per Person	State - Cost Per Person	Federal - Cost Per Person	Source
Mental illness	Behavioral Health & Crisis Services	Crisis Intake & Trauma Services	Access to Behavioral Health Services	County - DHHS														
Housing support	Special Needs Housing	Homeless Services	Family Shelter	County - DHHS														
Parenting and childcare issues	Children, Youth, and Family Services	Child Welfare	Early Childhood Services - Infant and Toddler program	County - DHHS														
Job training	Arbor Education & Training	Job training assistance		Other														
Income assistance	Children Youth and Families	TCA		County														
Nutrition	Children Youth and Families	SNAP	Food Stamps	County														
Nutrition	Department of Health & Mental Hygiene (DHMH)	WIC	Nutrition Supplement and Counseling	State														
Funding	Department of Health & Mental Hygiene (DHMH)	MCHP (MD Children's Health Program)	(Funding for healthcare)	State														
Child care	Child, Youth & Family Services	Child Care Subsidy	County Working Parents Assistance Program	County - DHHS														
Child care	Child, Youth & Family Services	Child Care Subsidy	State Child Care Subsidy Program	State														

\*Table only displayed for demonstrating the structure of the data. Actual cost of service delivery data is hidden due to confidentiality agreements with MC DHHS

#### 4. Establishing impact

In preparation for their interoperability project, the MC DHHS assembled an expert workgroup of the electronic Service Area Representatives (eSARS), with representatives from every service delivery and administrative division, to negotiate strategies and find ways of how they could

operate in coordination once the interoperability project is operational. During their regularly scheduled meetings, the eSARS committee not only discussed operational and technical details of data sharing, but it also elaborated on the ethical implications and the impacts of this collaboration on the overall wellbeing and privacy of the clients.

The JHU team arranged a special meeting with the eSARS committee. Prior to this meeting, the JHU team presented the eSARS committee with a diagram of the Life of the Case model (shown in Figure 3.2) and asked the committee members to elaborate on the amount of time each of the stages of the Life of the Case would consume in their respective divisions under As Is and To Be. During the meeting, the representatives explained the times they had reported. They also described which services would change after the implementation of interoperability under To Be and how that change would influence their collaboration with other departments that worked with that persona.

The JHU team also asked about the clients' chances of Spiraling Up under the present circumstances (As Is), as well as what the chances would be under the interoperable state (To Be). The answer to this question clarified that the package of services the client receives is different under As Is and To Be. This difference leads to a change in the probability of Spiral Up and Spiral Down. The eSARS committee had a consensus that under the As Is package of services, a mere 10% of the clients would Spiral Up, while with the To Be package of services that 30% of the clients would be able to Spiral Up.

In addition, one of the issues that was raised by the eSARS team as a barrier to interoperability is different professional cultures between social workers from different sections of the MC DHHS. These cultural differences were a major cause of the hesitancy of various departments to share client data with their colleagues from other departments often had their roots in experiences from the past, which had created difficulties both for the clients and the social workers. One of the difficulties that is more profound, and several social workers of the eSARS



committee mentioned it during the meeting, is the existing mistrust issues to share data between the divisions of Behavioral Health and Crisis Services with the Division of Special Needs Housing. The social workers who worked in the Division of Special Needs Housing argued for the implementation of interoperability mentioning that in the past, when Behavioral Health and Crisis Services had not shared client data with them, they had housed client patients with severe mental illness with other clients. This had led in some cases to severe danger and even the injury of clients. This is while the social workers from the Behavioral Health and Crisis Services division feared that if they shared client diagnostic data with their colleagues from the Division of Special Needs Housing, it would lead to discrimination against their clients and ultimately the client's inability to find safe housing.

The concerns raised by the social workers from the Behavioral Health and Crisis Services division are examples of the type of problems that may arise from implementing interoperability. Due to the ethical and legal nature of these types of problems, the ICMC does attempt to quantify their repercussions. This is a shortcoming of the ICMC, and the discussion chapter discusses this shortcoming in further detail.

After meeting with the eSARS committee, the JHU proceeded on a systematic literature review of all six of the personas. The objective of this search was to find studies that had documented the impact and effect of various welfare programs on clients similar to the persona.

## 5 Assigning cost values to services and outcomes;

## 6 Assigning probabilities to probabilistic values of services and outcomes

### ***Literature Review***

The objective of the systematic literature review was to find empirical evidence to the personas so this evidence would characterize each persona and operationalize its needs through consistent measures independently of the others. This review is completed with the specific objectives to assign ranges of cost values to services and outcomes, and to assign ranges of probabilities to the probabilistic values of services and outcomes

The persona statuses that were of interest to this study included:

- Homelessness
- Unemployment
- High school graduation
- GED
- Minimum wage employment
- Social cohesion
- Social Capital
- Teenage pregnancy
- Foster care
- Integrated teams

The searches conducted for each of these statuses, were according to the following criteria:

### Setting

This search utilized the Web of Science database through Welch Medical Library at Johns Hopkins University. The Encyclopedia of Library and Information Science describes (Drake, 2004.) the Web of Science (WoS) as:

***an online subscription-based scientific citation indexing service maintained by Thomson Reuters that provides a comprehensive citation search. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialized sub-fields within an academic or scientific discipline (Drake, 2004.)***

The Web of Science covers a broad array of literature from the medical, social, humanities, and engineering sciences and offers various search utilities including the execution of complex Boolean queries, preexisting tags for articles, as well as the direct import of references into the reference manager EndNote. Web of Science consists of several online databases, which include:

***“Conference Proceedings Citation Index covers more than 148,000 conference titles in the Sciences starting from 1990 to the present day  
Science Citation Index Expanded covers more than 8,500 notable journals encompassing 150 disciplines. Coverage is from the year 1900 to the present day.  
Social Sciences Citation Index covers more than 3,000 journals in social science disciplines. Range of coverage is from the year 1900 to the present day.  
Arts & Humanities Citation Index covers more than 1,700 arts and humanities journals starting from 1975. In addition, 250 major scientific and social sciences journals are also covered.  
Book Citation Index covers more than 30,000 editorially selected books starting from 2005” (Thomson-Reuters, 2013).***

#### Inclusion exclusion criteria

##### Exclusion Criteria:

- a- Not found within the Web of Science database
- b- Not relevant to the persona stages listed above or estimates of costs, or Disability

Adjusted Life Years (DALY) or Quality Adjusted Life Years (QALY) through sequential methods of query Web of Science database, title review, and abstract review.

- c- To be published outside the range of years between 1995 and 2013.

##### Inclusion Criteria:

- a- To be included within the references of articles found through applying the exclusion criteria and deemed relevant to the objective of the study.

## Queries

Boolean searches were conducted in the Web of Science database to fit the exclusion criteria. In order to assure the inclusion of all relevant articles, the queries employed wildcards. A wildcard allows the expansion of the search so that its results include all words that have the segment before the wildcard. For example searching for 'Homeles\*' will include Homelessness, and Homeless. Table 3.6 lists the exact search terms used.

**Table 3.6- Query keywords used in the systematic review**

<b>Persona issue of interest</b>	<b>Search term combined with 'dollar*' 'cost' 'QALY' 'DALY'</b>
Homelessness	Homeles*
Unemployment	Unemployment
Minimum wage employment	Minimum wage
High school education	High school education
GED	GED
Social cohesion	Social cohesion
Social Capital	Social capital
All combinations of Teenage, Teenagers, and Teen, with pregnant, and pregnancy	Teen* pregnan*
Foster care	Foster care
All combination of Integrate, Integrated, and Integrating with team and teams.	Integrat* team*

Similar to the search for high school education and GED, the searches for social cohesion and social capital, as well as the search for minimum wage and unemployment were also combined. The objective of these combinations was to reduce the number of redundant and repetitive titles, which were likely to appear in both searches. An example query for the persona status

'homelessness' is presented below and a similar query was repeated for each of the persona stages listed in Table 3.6.

# 1

TS=(Homeles\*) AND TS=(Cost) AND PY=(1995-2013)

Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=1995-2013

# 2

TS=(Homeles\*) AND TS=(QALY) AND PY=(1995-2013)

Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=1995-2013

# 3

TS=(Homeles\*) AND TS=(DALY) AND PY=(1995-2013)

Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=1995-2013

# 4

TS=(Homeles\*) AND TS=(dollar\*) AND PY=(1995-2013)

Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=1995-2013

# 5

#4 OR #3 OR #2 OR #1

## Title review

Article titles were reviewed within Web of Science interface, and selected relevant articles along with their tags were imported into the EndNote reference manager.

## Abstract review

Upon the completion of all searches, selected articles stored within the EndNote reference manager underwent an abstract review, and those references determined to be irrelevant to the objective of the study were omitted.

## Full text review

The selected articles deemed relevant through title and abstract review went under full text review for extraction of the relevant information.

## References review

Relevant references of reviewed articles also went under full text review for extraction of the relevant information.

## Extraction of information and reporting results

Results were extracted and information is summarized in league tables with the following headings:

<b>Author (Date)</b>	<b>Location</b>	<b>Model type</b>	<b>Authors purpose</b>	<b>Method</b>	<b>Target Population</b>	<b>Results</b>	<b>Beginning State(s)</b>	<b>End State(s)</b>	<b>Units</b>	<b>How many units</b>
--------------------------	-----------------	-----------------------	----------------------------	---------------	------------------------------	----------------	-------------------------------	-------------------------	--------------	-------------------------------

## Post-hoc searches

Two groups of post hoc searches were conducted. The first search was conducted on the references of the found articles, and second was ad hoc searches. The aim of these searches was to find specific data needed for the original ICMC, but which the systematic review had not revealed.

## **Parameters**

The parameters for the core decision tree are the baseline costs of providing care under As Is and To Be and the costs and probabilities of Spiral Up, and Spiral Down under As Is and To Be. Variables for outcomes include the costs for implementing the interoperable system and costs of services, income, outcomes, and secondary effects. Probabilities include probabilities of receiving services, adherence to treatment, spiraling (up or down), receiving income, bad outcomes, and secondary effects.

## **Outcomes**

The outcomes are the change in the values of housing, education, employment, access to healthcare and permanent connections (HEEAP) between Spiral Up and Spiral Down. Table 3.2 provides the working definition of MC DHHS for the HEEAP outcomes.

The other outcome variable is the probability that the client will fall into the Spiral Up (or Spiral Down) path under As Is and To Be. The ICMC model, expresses probabilities as odds ratios to enable sensitivity analysis that does not lead to errors, when machine-based probabilities go below zero or above one. This violation could occur, because eSARs expressed the probabilities of Spiraling Up or Down as related to each other. In order for the sensitivity analysis to maintain that relationship, one probability must relate to another via some factor. However, if, in the sensitivity analysis, the base probability is high, then the calculated value of the other probability could become greater than one. The use of odds instead of probability would have not solved the problem either, given that odds cannot tolerate negative values. By utilizing the Odds Ratio, which may vary from zero to positive infinity, the ICMC avoids this problem of meaningless probability thresholds. Alternatively, if odds are used, an odds greater than 1 results in a valid probability. The relationship in which the ICMC links the  $p_{Spiral\ Up\ |\ To\ Be}$  with the  $p_{Spiral\ Up\ |\ As\ Is}$  is as follows:



$$p_{Spiral\ Up\ |\ To\ Be} = \frac{(Odds\ Ratio_{Spiral\ Up\ |\ To\ Be\ /\ As\ Is}) \times (p_{Spiral\ Up\ |\ As\ Is})}{(1 + p_{Spiral\ Up\ |\ As\ Is}) \times (Odds\ Ratio_{Spiral\ Up\ |\ To\ Be\ /\ As\ Is} - 1)}$$

## Input parameters

One of the input parameters is the cost of implementation of interoperability (To Be as defined by successful implementation and operation of ITP and eICM), compared to the lack of it (As Is) where the cost is zero.

Another input parameter is the value of the service package the clients receive under As Is as well as To Be.

Thus the costs that are considered are:

- a) Expected Cost of Spiraling Up
- b) Expected Cost of Spiraling Down

Given that Spiraling Up and/or Spiraling Down can occur under both As Is and To Be, the combinations are:

- 1- Expected Cost of Spiraling Up under As Is
- 2- Expected Cost of Spiraling Up under To Be
- 3- Expected Cost of Spiraling Down under As Is
- 4- Expected Cost of Spiraling Down under To Be

Hence the relevant costs differences are:

### **A. Expected cost under As Is =**

[(Expected Cost of Spiraling Down under As Is × Probability of Spiraling Down under As Is) + (Expected Cost of Spiraling Up under As Is × Probability of Spiraling Up under As Is)]

and

**B. Expected cost under To Be =**

Investment cost that happens only under To Be + [(Expected Cost of Spiraling Down under To Be  $\times$  Probability of Spiraling Down under To Be) + (Expected Cost of Spiraling Up under To Be  $\times$  Probability of Spiraling Up under To Be)]

## 7. Calculations

Prior to embedding the data into the decision tree model, the analytical tasks require data cleaning, data integration, and the actual data analysis, where the “data” are estimates for the key parameters in the model. The data-cleaning step involves obtaining the estimates and ranges from the key informants as well as from the literature as shown in Table 3.5. Since the Accenture ROTI informs this model, Accenture consultants cooperated with the data cleaning steps. The JHU team, in turn, gathered additional evidence entirely from the systematic literature review and interviews it performed. To protect decision making in MC DHHS, the data reported are from the ranges elicited.

Data integration includes the development of detailed tables for documenting the probabilities and costs. As demonstrated in Table 3.7 for the homeless family persona, the data integration process includes cost data from the Accenture ROTI analysis. It also displays probabilities gathered predominantly from the literature, as well as from the eSARS interview. As revealed in Table 3.7, the probabilistic nature of this model is only meaningful given the upper and lower bounds of the costs and the probabilities. While these upper bounds and lower bounds do not reveal themselves in the calculated final baseline average costs, they find importance in sensitivity analysis stages when calculating the range over which the final average costs can vary.

For performing the data analysis, the JHU team had the option of using commercial software such as TreeAge (TreeAge Software Inc., 2009). However, since the design of the ICMC needs to be in a way that managers could later use it in places with limited resources, the agreed medium between MC DHHS and the JHU team became the Microsoft Excel spreadsheet with open source visual basic macros embedded. The JHU team employed a professional programmer for the coding of the visual basic macros in the Excel environment.

**Table 3.7- Data integration for the persona of a homeless family**

Homeless Family

Definition
21-year-old single mother with multiple children, no access to housing, no income, severe mental health diagnosis

Overview of value model	Client Value	Direct Social Value	Indirect Social Value
Spiral up	Work income due to completing high school	No unemployment benefits	Reduced second pregnancy
		No housing need (Bundled services)	No foster care
		(Deadweight: Housing)	(Deadweight: child care)
Spiral down	Work income		

For Sensitivity Analysis							
Name	Value	Lo	Hi	Number of intervals	Selection	Comment	Source
Probabilities	Likelihood of spiraling up, As-is	0.100000001	0	1	6✓		Ron Rivlin, eSARs
	Odds ratio of success due to To-Be bundle/process	4	1	5	6✓	Includes client's likelihood to follow through	
	Percent of max that Interop ToBe is expected to be realized	1	0.1	1	6✓	Enables alternative scenarios. A value of 1 represents maximum interoperability	
	Percent of max that ITP To-Be is expected to be realized	0.300000012	0.1	1	6✓	Enables alternative scenarios	
	Likelihood second pregnancy, Spiral Down	0.66	0.30	0.90	6✓	Based on homeless young women	(Key, 2008 #261)
	Likelihood second pregnancy Spiral Up	0.10	0.05	0.30	6✓	Based on homeless young women	(Barnet, 2010 #250;Key,2008 #261)
	Likelihood of foster care need, placement, Spiral Down	0.27	0.10	0.40	6✓	Based on homeless young women	(, 2011 #615)
Dollars for value	Annual income, Spiral Down	\$ 0	\$ 0	\$ 10,000	6✓	Based on persona: Set as zero, but could be changed by other users	
	Annual income, Spiral Up				6✓	Based on graph of average annual earnings for dropouts, GED, and High School grads. This number is the dropout earnings for a 42 year old.	(Rouse, 2007 #634)
		\$ 10,000	\$ 50	\$ 20,000	6✓		
	Annual housing subsidy, Spiral up	\$ 9,240	\$ 5,000	\$ 12,000	6✓	Section 8: (Montgomery Fair Market Rent of 1270 - max out of pocket of \$500) * 12	<a href="http://average-rent.findthedata.org//8329/20904">http://average-rent.findthedata.org//8329/20904</a>
From ROTI Cost Avoidance	Annual cost of unemployment benefits				6✓	Federal	
		\$ 4,000	\$ 0	\$ 5,000	6✓		
	Annual cost of Food Stamps	\$ 1,800	\$ 0	\$ 2,000	6✓	Federal	
	Annual cost of WIC	\$ 600	\$ 0	\$ 1,000	6✓	Federal	
	Annual cost of Childcare	\$ 1,500	\$ 0	\$ 2,000	6✓	State	
	Annual cost of SNAP	\$ 1,700	\$ 0	\$ 2,000	6✓	Federal	
	Annual cost of foster care, 1 child	\$ 35,000	\$ 10,000	\$ 50,000	6✓	State	
	Annual cost of Homeless Family, As-is	\$ 18,000	\$ 10,000	\$ 40,000	6✓	County	
Costs	Annual cost of Homeless Family, To-Be	\$ 30,000	\$ 10,000	\$ 50,000	6✓	County	
	Cost of As-is bundle year 1	\$ 30,000	\$ 20,000	\$ 90,000	6✓	Baseline costs	
	Max Interop cost change of To-Be service bundle	(\$ 5,000)	(\$ 10,000)	(\$ 5,000)	6✓	Uses 100%-interop Year 5 of ROTI model	
	Max ITP cost change of To-Be service bundle				6✓	Uses 30%-ITP Year 5 of ROTI model and multiplies by 3.3, for max	
		\$ 40,000	\$ 10,000	\$ 50,000	6✓		
	Cost of second teen birth	\$ 3,600	\$ 1,000	\$ 10,000	6✓		(Key, 2008 #261)
	Annual cost of Spiral Down services, As-is	\$ 18,000	\$ 10,000	\$ 30,000	6✓	Same as Homeless Family, As is	
	Annual incremental cost of Spiral Down services, To-Be	\$ 11,000	\$ 5,000	\$ 20,000	6✓		

The first step of the calculations was to derive the annual cost of the package of services under As Is and To Be as shown in the top portion of Table 3.8. This is done by adding the components of the costs from Table 3.7. The calculator calculates the parameters of the model based on these bundle costs.

The bottom section of Table 3.8 displays that the parameters of the model depend on the perspective, which drives value. This study includes three value perspectives (Client, Social Direct, and Social Indirect), which when summed result into the total SROI value. The ICMC calculates the

difference between the As Is value, and the To Be value (as well as the range of this difference) on a per annum basis for each perspective. It should than be considered that although the package of services may not differ, the probability of receiving services goes down as the years pass as shown in Figure 3.5.

**Table 3.8- Calculations and parameter derivations for homeless family persona**

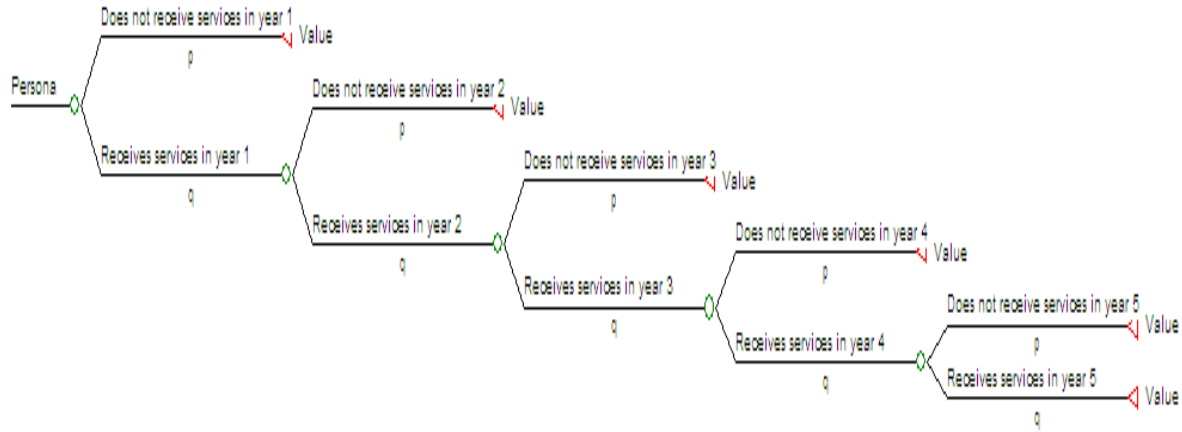
Calculated (Hi/Lows are calculated as well)	Foster care multiplier	1.56	1.25	1.60		i.e., expected number of children going into foster care
	Cost of To-Be bundle year 1	\$ 65,000	\$ 30,000	\$ 60,000		By calculating To-Be, we keep As-Is and To-Be costs linked during sensitivity analysis
	Annual cost of Spiral Down services, To Be	\$ 29,000	\$ 15,000	\$ 50,000		By calculating To-Be, we keep As-Is and To-Be costs linked during sensitivity analysis. Sum of Spiral Down As Is plus additional To Be services---for homeless families
	Annual cost of Spiral Up services, To Be	\$ 65,000	\$ 20,000	\$ 135,000		
	Annual cost due to Spiral Down foster care	\$ 54,600	\$ 12,500	\$ 80,000		Annual cost of foster care
	Annualized cost of pregnancy	\$ 504	\$ 63	\$ 1,500		Takes into account differential pregnancy rate between Spiral Down and Spiral up, and spread over 4 years
<b>FOR PARAMETER SPECIFICATION</b>						
Cost of services	Cost of As-Is spiral up	\$ 30,000	\$ 20,000	\$ 90,000	Year 1 investment	
	Cost of As-Is spiral down	\$ 30,000	\$ 20,000	\$ 90,000	Year 1 investment	
	Cost of To-Be spiral up	\$ 65,000	\$ 30,000	\$ 60,000	Year 1 investment	
	Cost of To-Be spiral down	\$ 65,000	\$ 30,000	\$ 60,000	Year 1 investment	
Probability of Sp	As-Is	0.10	0.00	1.00		
	To-Be	0.31	0.00	1.00		
<b>AS-IS VALUE</b>						
Spiral Up	Client Value	\$ 40,000	\$ 200	\$ 80,000	Income	
	Direct Social Value	\$ 99,040	\$ 60,000	\$ 332,000	Service bundle + unemployment avoided - housing subsidy	
	Indirect Social Value	\$ 198,016	\$ 50,250	\$ 298,000	Pregnancy + foster caer - child care	
	Total Value	\$ 337,056	\$ 110,450	\$ 710,000	Costs avoided from crime	
Spiral Down	Client value	\$ 44,000	\$ 20,000	\$ 80,000	Income	
	Direct Social Value					
	Indirect Social Value					
	Combined value	\$ 44,000	\$ 20,000	\$ 80,000		
<b>TO-BE VALUE</b>						
Spiral Up	Client Value	\$ 40,000	\$ 200	\$ 80,000	Income	
	Direct Social Value	\$ 95,040	\$ 40,000	\$ 172,000	Service bundle + unemployment avoided - housing subsidy	
	Indirect Social Value	\$ 198,016	\$ 50,250	\$ 298,000	Pregnancy + foster caer - child care	
	Total Value	\$ 333,056	\$ 90,450	\$ 550,000	Costs avoided from crime	
Spiral Down	Client value	\$ 44,000	\$ 20,000	\$ 80,000	Income	
	Direct Social Value					
	Indirect Social Value					
	Combined value	\$ 44,000	\$ 20,000	\$ 80,000		

In order to calculate this annualized cost of service, the model assumes that the probability of not receiving the service is p, thus the probability of receiving the service is 1-p or q. If the cost of the service is C and cost of not receiving the service is D, the total cost over the four years becomes:

$$\left( \left( (p * ((q) + 2 * (q)^2 + 3 * (q)^3) + 4 * (q)^4) \right) * D \right. \\ \left. + ((p * (3 * (q) + 2 * (q)^2 + (q)^3) + 4 * p^4) * C) \right)$$

Since the ICMC calculates this for the four years, it calculates the average per annum as:

$$\left( \left( (p * ((q) + 2 * (q)^2 + 3 * (q)^3) + 4 * (q)^4) \right) * D \right. \\ \left. + ((p * (3 * (q) + 2 * (q)^2 + (q)^3) + 4 * p^4)) * C \right) / 4$$



**Figure 3.5- Probability of receiving service in consecutive years**

The ICMC finds the result for the totals for this persona by multiplying the per annum basis by a total of four years. Multiplying the result of the totals for this persona by the number of clients reported to match this persona, results in sum for this persona.

## Chapter 4 – Original ICMC Results

### Introduction

The design of the Intensive Case Management Calculator (ICMC), as introduced in Chapter 3, is such that it produces not only numerical monetary amounts, but also includes a text analysis with solid recommendations accompanied with graphical illustrations and tornado diagrams. The results intend to inform health and human services administrators, specifically at the county level, to make better-informed financial decisions on whether to invest on interoperability or not. These results are dependent on the type of client persona, and the number of clients of the county health and human services department.

The ICMC can accommodate up to six different types of client personas. As discussed in Chapter 3, the six client personas of the original design (hereafter named the original ICMC) included a child aging out of the disabilities program, a pregnant teen, a child aging out foster care, a homeless young adult, a homeless family, and a homeless single adult. Montgomery County Department of Health and Human Services (MC DHHS) selected these clients.

This chapter focuses on the results of the model building effort described in Chapter 3. These results were delivered to MC DHHS prior to the writing of this dissertation in forms of a whitepaper (Lehmann, 2014a) as well as a user manual for the ICMC Excel based program (Lehmann, 2014b). This chapter starts with a presentation of the results of the interviews and literature review, which provided the raw data for the original ICMC and will continue to present the results of the original ICMC. This chapter concludes with the recommendations based on the results of the ICMC.

## Findings from the interviews

During the mapping of the outcomes and meeting with the representatives from the Maryland Department of Human Resources as well as Five Points consultants, who had worked to measure the timing of each of the MC DHHS care delivery processes, the difference in time that caseworkers may spend on each stage of the life of the case model became clear. In many cases, even though the difference between As Is and the first visit under To Be may have been small, the difference between As Is and subsequent visits under To Be is significant. Table 4.1 displays these time differences.

**Table 4.1- Life of the case time difference between As Is and To Be\***

Phase	Subphase	AsIs		ToBe			
		At least	At most	1st service		later service	
				At least	At most	At least	At most
Screening	Demographics	15 minutes	15 minutes	15 minutes	15 minutes	0 minutes	0 minutes
Screening	Triage	2 hours	4 hours	5 minutes	10 minutes	5 minutes	10 minutes
Intake and Eligibility	Intake	45 minutes	45 minutes	5 minutes	5 minutes	5 minutes	5 minutes
Enrollment	Enrollment	30 minutes	2 hours	30 minutes	2 hours	30 minutes	2 hours
Assessment	Assessment	No Difference					
Service Strategy	Service Strategy	1 hour	3 days	1 hour	1 hour	0 minutes	0 minutes
Case Management	Service referral	2 hours	8 hours	30 minutes	2 hours	30 minutes	2 hours
Case Management	Service Provision	Improvement not quantified					
Service Transaction	Getting Information Back	2 hours	2 hours	0 minutes	20 minutes	0 minutes	20 minutes
Case Dispensation	Case Dispensation	1 day	3 days	15 minutes	1 day	15 minutes	1 day

*\*As estimated and reported through the mapping efforts of Five Point*

In addition, the interviews with the eSARS group revealed that the probability of Spiral Up under As Is would be 10% and this would increase to 30% under To Be. The interviews and the



ROTI model also led to other administrative micro financial data on the cost of services, which due to respect for the privacy of MC DHHS cannot be reported.

Furthermore, the estimated cost of implementation of interoperability (To Be as defined by successful implementation and operation of ITP and eICM), is \$308 per client as calculated in Table 4.2. This is compared to the lack of interoperability (As Is) where the cost is zero..

**Table 4.2- Calculation of the per client cost of implementing interoperability**

Fixed Cost	eICM system implementation cost = \$22,150,000 (one time cost) eICM Organizational Change Management costs (estimated budget) = \$350,000	Includes system implementation, project management, hardware, software licenses, 10% contingency	\$22,150,000 + \$350,000 = \$22,500,000
Fixed Cost (scaled down)	eICM system implementation cost per MC DHHS client	\$22,500,000 divided by 81,500 clients = \$276.07	\$276 per client
Recurring Cost	eICM maintenance & operations (M&O) cost = \$1,820,000 (annual recurring cost)	Includes M&O services, project management, infrastructure hosting and maintenance, software license fees	\$1,820,000 per year
Recurring Cost	Personnel cost for ITP	Additional case worker annual salary for ITP implementation	\$300,000 per year
Total Recurring Cost	eICM (M&O) + ITP	\$1,820,000 + \$300,000	\$2,120,000 per year
Recurring Cost (scaled down)	eICM (M&O) + ITP cost per MC DHHS client year	\$2,120,000 per year divided by 81,500 client = \$26.01 per client year	\$26 per client year
Total Cost (scaled down)	Total eICM cost per client	\$276 + \$26 = \$302	\$302 per client
Inflation Rate	Average US inflation 2009 – 2013	2%	2%
Cost (adjusted)	Total eICM cost per client adjusted for inflation	\$302 + 2% = \$308	\$308 per client

## Parameter Values from the Literature

The search for evidence related to the personas and their end stages yielded a total 6857 titles for the Homeles\*, Unemployment & Minimum wage, High school education & GED, Social cohesion & Social Capital, Teen\* pregnan\*, Foster care, and Integrat\* team\* terms combined in a Boolean AND combination with ‘dollar\*’ ‘cost’ ‘QALY’ ‘DALY’. Of the 6857 titles, 6375 titles either met the exclusion criteria or did not meet the inclusion criteria and 482 (7.56%) were selected for abstract review. Of the 482 reviewed abstracts, 407 either met the exclusion criteria or did not meet the inclusion criteria and the 75 remaining (15.56% of the abstracts and 1.09% of all titles) were used as persona evidence. Table 4.3 summarizes the breakdown of the stages of the search.

**Table 4.3- Breakdown of reviewed articles of the systematic review**

<b>Search term combined with ‘dollar*’ ‘cost’ ‘QALY’ ‘DALY’</b>	<b># of titles found, and reviewed</b>	<b># of abstracts selected, and reviewed</b>	<b># of full text articles selected, retrieved, and reviewed</b>
Homeles*	411	109	33
Unemployment Minimum wage	1776	88	4
High school education GED	1117	83	8
Social cohesion Social Capital	1438	52	3
Teen* pregnan*	126	28	15
Foster care	504	62	4
Integrat* team*	1485	60	8
<b>Total</b>	6857	482	75

The post-hoc searches of references resulted in 9 additional articles.

The 75 articles found were categorized according to their use in the persona cost models. Of these articles, 14 were theoretical articles that were devoid of any usable data for the model, but rather included usable background information on the persona or treatment they represented. These articles are summarized in Table 0.1 in the Appendix.

The second group of 27 articles contained cost data of interventions. Table 0.2 in the Appendix summarizes these articles. The final group of 34 articles contained statistical information on the effect of interventions or characteristics of the population. These statistics were presented either in the form of probabilities, odds ratios or other parametric measures. Table 0.3 in the Appendix is a summary of these articles.

In addition to the 75 articles systematically reviewed in detail in this chapter, post-hoc searches for data that were missing for the ICMC were performed and revealed 9 additional references which were used in the ICMC (Gigerenzer & Selten, 2001; Hadorn, 1991; Lawson, Kearns, Petticrew, & Fenwick, 2013; Lee & Miller, 2009; Lehmann, Dambita, Buchanan, Casella, & Subcommittee, 2011; Palepu, Patterson, Moniruzzaman, Frankish, & Somers, 2013; Rice, Lee, & Taitt, 2011; Rouse, 2007). Collectively with the 75 articles, these articles provided key data on costs and probabilities for relevant personas. As an example, for the Pregnant Teen persona, the Barnet, Rapp, DeVoe, & Mullins (2010) and the Key, Gebregziabher, Marsh, & O'Rourke (2008) articles (both found from the systematic review) provided the probabilities for a second pregnancy under the Spiral Up and Spiral Down conditions. Rouse (2007) delivered cost information on potential income from employment, and was found in the post hoc searches. Table 4.4 is a replication of the relevant rows of the ICMC, where data from the above articles are used.

**Table 4.4- Use of literature data in the ICMC**

<b>Name</b>	<b>Value</b>	<b>Lo</b>	<b>Hi</b>	<b>Comment</b>	<b>Source</b>
Likelihood second pregnancy, Spiral Up	0.10	0.05	0.20	Rate of second teen pregnancy in domiciled, high school attendees	(Barnet, Rapp, DeVoe, & Mullins, 2010; Key, Gebregziabher, Marsh, & O'Rourke, 2008)
Odds ratio for second pregnancy, Spiral Down	17	5	30	Odds ratio for pregnant teens	(Key, et al., 2008)
Annual income, Spiral Up	\$10,000	\$50	\$20,000	Based on graph of average annual earnings for dropouts, GED, and High School grads. This number is the dropout earnings for a 42 year old.	(Rouse, 2007)

## Results of the original ICMC with the original six personas

The cumulative results of the modeling effort led to the creation of the Intensive Case Management Calculator (ICMC) for Social Return on Investment (SROI). Figure 4.1 shows the ICMC dashboard. The right hand side of the dashboard allows for the user to select the number of personas needed to be included in the model, the perspective of the model, as well as whether the use of the ICMC is for a cost benefit analysis (\$/\$) or for a cost effectiveness analysis (\$/DALY). The left hand side of the dashboard consists of the buttons that execute the functions and run the analysis. The ICMC guides the user from inputting the parameters, to receiving a text and graphical report for the base case, and sensitivity analysis.

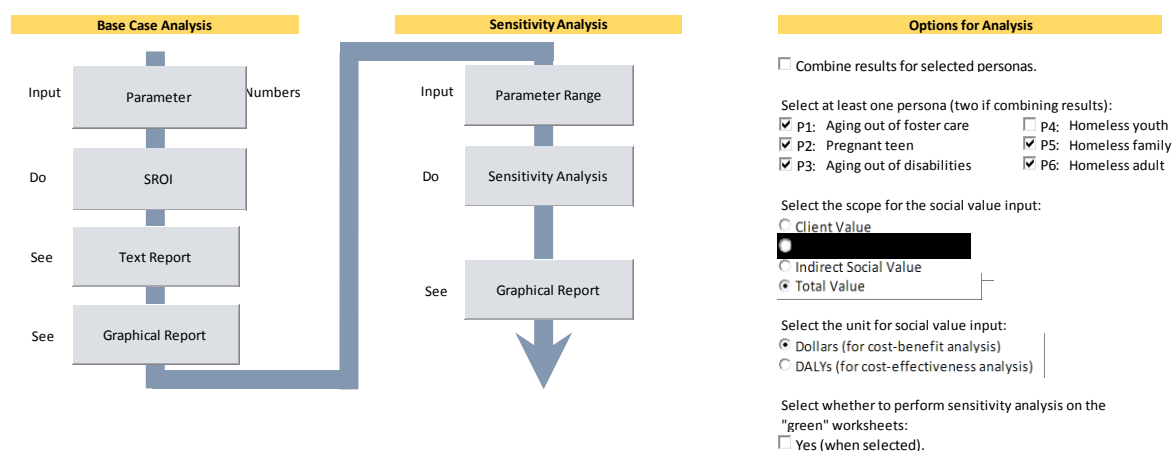


Figure 4.1- ICMC Dashboard

## Text Results

When the parameters collected during the additional interviews, the literature reviews, and the ROTI study were fed into the ICMC model, and the model is run, the results for all personas are displayed in Table 4.5. In addition, the ICMC delivers the following text report for the Aging out of foster care persona, and constructs a similar report for each of the other personas.

***“Because the expected investment difference is negative, To Be is expected to cost \$16,920 less than As Is. The number of improved clients ('Spiral Up') is 2 more in To***

*Be than As Is. To Be is expected to cost \$8,147 for every client helped to 'spiral up,' less than what As Is would have accomplished. Because the expected value difference is positive, To Be is expected to confer greater value to society altogether. The expected difference in value is greater than the expected cost of investment, so To Be is expected to provide greater net benefit to society altogether."*

**Table 4.5- Text report of cost-benefit analysis for total social value for all personas**

<b>Persona</b>	<b>[1.] Expected Investment Difference (To Be – As Is)</b>	<b>[2.] Difference in Expected Number of Spiral-up Cases (To Be – As Is)</b>	<b>[1.] divided by [2.] Cost/ Effectiveness</b>	<b>[3.] Expected 'Total Social' Value Difference (To Be – As Is)</b>	<b>[3.] minus [1.] Cost-Benefit (Expected Value Difference - Expected Investment Difference)</b>
Aging out of foster care	(\$16,920)	2	(\$8,147)	\$584,751	\$601,671
Pregnant teen	\$3,080	2	\$1,483	\$1,069,253	\$1,066,173
Aging out of disabilities	\$178,926	2	\$86,150	\$586,370	\$407,444
Homeless youth	(\$36,920)	1	(\$45,124)	\$239,625	\$276,545
Homeless family	\$706,160	4	\$170,001	\$1,192,694	\$486,534
Homeless adult	\$2,361,600	42	\$56,853	\$13,824,522	\$11,462,922

The most important parameter in Table 4.5 is the difference in the number of expected cases that would Spiral Up under As Is and To Be. In the case of the Homeless adult, for example, the total number of Homeless adult clients that MC DHHS reports is 200. Under As Is only 10% would Spiral Up which results in 20 cases of Spiral Up. Under To Be 31% would Spiral Up, which results in 62 cases of Spiral Up. The difference between As Is and To Be is therefore the 42 cases that Table 4.5 displays.

Table 4.6 through Table 4.10 present the combined results of the tables and the interpretive text report that the ICMC produces. Table 4.6 presents the difference in the number of clients expected to Spiral Up under To Be and As Is, followed by the projected extra costs of the implementation of Interoperability for that cohort of clients. The ICMC calculates the resulting cost consequence by dividing the difference in costs by the difference in number of improved clients.

**Table 4.6- The costs and cost-consequences from the original ICMC**

	Persona		Aging out of Foster Care	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Number	Total Client Population		10	10	10	10	20	200
	Difference in number of Spiral-up Cases	(ToBe - AsIs)	2	2	2	1	4	42
	Base Case Interpretation		The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 1 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 4 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 42 more in To-Be than As-Is.
Cost	Expected Investment Difference	(ToBe - AsIs)	\$ (16,920)	\$ 3,080	\$ 178,926	(\$ 36,920)	\$ 706,160	\$ 2,361,600
	Base Case Interpretation		Because the expected investment difference is negative, To-Be is expected to cost \$16,920 less than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$3,080 more than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$178,926 more than As-Is.	Because the expected investment difference is negative, To-Be is expected to cost \$36,920 less than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$706,160 more than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$2,361,600 more than As-Is.
Cost-Consequence	Expected Investment Difference / Difference in number of Spiral-up Cases		(\$ 8,147)	\$ 1,483	\$ 86,150	(\$ 45,124)	\$ 170,001	\$ 56,853
	Base Case Interpretation		To-Be is expected to cost \$8,147 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$1,483 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$86,150 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to cost \$45,124 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$170,001 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$56,853 for every client helped to 'spiral up,' over what As-Is would have accomplished.



## Values generated

While the costs of the investment are as the figures in Table 4.6 show, the value of the benefit depends on the perspective. Table 4.7, Table 4.8, and

Table 4.9, reveal the values of the benefits and net benefits (benefits – investment) from the perspectives of the client, the social direct perspective, and the social indirect perspective respectively.

Table 4.10 is simply a sum of the relevant values from Table 4.7, Table 4.8, and

Table 4.9 that adds up to the total SROI value. Sensitivity analysis results for client, social direct and social indirect perspectives are also feasible but not displayed, for brevity. However, the discussion of model verification in Chapter 5 presents a section that includes a comparison of the results of the original ICMC and modified ICMC, in which the sensitivity analysis of benefits and net cost-benefits are displayed and compared for the total social value perspective for three personas.

**Table 4.7- The ‘client’ value and cost-benefit from the original ICMC**

		Persona		Aging out of Foster Care	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Client	Expected 'Client' Value Difference	(ToBe - AsIs)	\$ 71,169	\$ 20,769	\$ 71,169	\$ 21,600	\$ (16,615)	\$ 1,005,829
		Base Case Interpretation		Because the expected value difference is positive, To-Be is expected to confer a greater value of \$71,169 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$20,769 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$71,169 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$21,600 to all clients.	Because the expected value difference is negative, To-Be is expected to confer a less value of \$16,615 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$1,005,829 to all clients.
		Cost-Benefit (Expected 'Client' Value Difference - Expected Investment Difference)		\$ 88,089	\$ 17,689	\$ (107,757)	\$ 58,520	\$ (722,775)	\$ (1,355,771)
		Base Case Interpretation		The expected difference in value is \$88,089 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to the clients.	The expected difference in value is \$17,689 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to the clients.	The expected difference in value is \$107,757 less than the expected cost of investment, so To-Be is expected to provide a net loss to the clients.	The expected difference in value is \$58,520 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to the clients.	The expected difference in value is \$722,775 less than the expected cost of investment, so To-Be is expected to provide a net loss to the clients.	The expected difference in value is \$1,355,771 less than the expected cost of investment, so To-Be is expected to provide a net loss to the clients.

**Table 4.8- The ‘direct social’ value and cost-benefit from the original ICMC**

		Persona		Aging out of Foster Care	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Direct Social Value	Expected 'Direct Social' Value Difference	(ToBe - AsIs)	\$ 513,582	\$ 829,231	\$ 515,200	\$ 53,726	\$ 386,782	\$ 12,333,524
		Base Case Interpretation		Because the expected value difference is positive, To-Be is expected to confer a greater value of \$513,582 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$829,231 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$515,200 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$53,726 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$386,782 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$12,333,524 to government agencies.
		Cost-Benefit (Expected 'Direct Social' Value Difference - Expected Investment Difference)		\$ 530,502	\$ 826,151	\$ 336,274	\$ 90,646	(\$ 319,378)	\$ 9,971,924
		Base Case Interpretation		The expected difference in value is \$530,502 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$826,151 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$336,274 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$90,646 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$319,378 less than the expected cost of investment, so To-Be is expected to provide a net loss to government agencies.	The expected difference in value is \$9,971,924 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.

**Table 4.9- The ‘indirect social’ value and cost-benefit from the original ICMC**

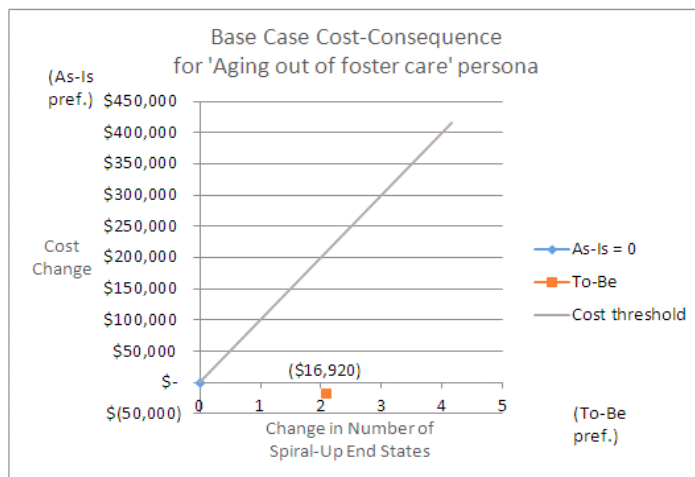
		Persona		Aging out of Foster Care	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Indirect Social Value	Expected 'Indirect Social' Value Difference	(ToBe - AsIs)	\$ 0	\$ 219,253	\$ 0	\$ 164,298	\$ 822,528	\$ 485,169
		Base Case Interpretation		Because the expected value difference is \$0 To-Be is expected to provide no net benefit or loss to the client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$219,253 of greater value to client's contacts.	Because the expected value difference is \$0 To-Be is expected to provide no net benefit or loss to the client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$164,298 of greater value to client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$822,528 of greater value to client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$485,169 of greater value to client's contacts.
		Cost-Benefit (Expected 'Indirect Social' Value Difference - Expected Investment Difference)		\$ 16,920	\$ 216,173	(\$ 178,926)	\$ 201,218	\$ 116,368	(\$ 1,876,431)
		Base Case Interpretation		The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$16,920 to client's contacts.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$216,173 to client's contacts.	The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide a net loss of \$178,926 to client's contacts.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$201,218 to client's contacts.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$116,368 to client's contacts.	The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide a net loss of \$1,876,431 to client's contacts.

**Table 4.10- The ‘total social’ value and net benefit from the original ICMC**

		Persona		Aging out of Foster Care	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Total Social Value	Expected 'Total Social' Value Difference	(ToBe - AsIs)	\$ 584,751	\$ 1,069,253	\$ 586,370	\$ 239,625	\$ 1,192,694	\$ 13,824,522
		Base Case Interpretation		Because the expected value difference is positive, To-Be is expected to confer \$584,751 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$1,069,253 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$586,370 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$239,625 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$1,192,694 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$13,824,522 of greater value to society altogether.
		Cost-Benefit (Expected 'Total Social' Value Difference - Expected Investment Difference)		\$ 601,671	\$ 1,066,173	\$ 407,444	\$ 276,545	\$ 486,534	\$ 11,462,922
		Base Case Interpretation		The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$601,671 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$1,066,173 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$407,444 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$276,545 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$486,534 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$11,462,922 to society altogether.

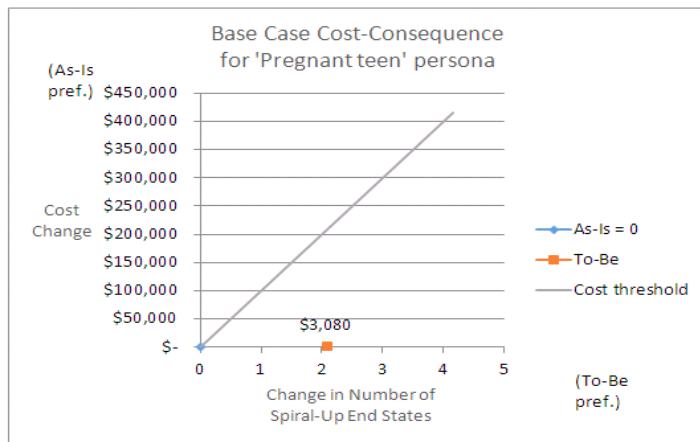
## Graphical Results

Figure 4.2 to Figure 4.7 display the graphical illustration of the cost-consequences calculated in Table 4.6. The ICMC produces these figures when the user pushes the graphical report button on the dashboard that Figure 4.1 displays. Each of these figures represents one of the personas of the original ICMC model. These figures depict the costs on the vertical (Y) axis, and represent the number of additional improved clients on the horizontal (X) axis. In Figure 4.2 the dollar amount of (\$16,920) above the square reflecting To Be, is the same as the dollar amount in Table 4.5 under the row Aging out of foster care and the column [1.] Expected Investment Difference (To Be – As Is). This amount is indicative of the costs it will take to create the 2 additional cases that spiral up under To Be, which is reflected on the horizontal axis of the graph and in the in column [2.] Difference in Expected Number of Spiral-up Cases (To Be – As Is) in the Aging out of foster care row.



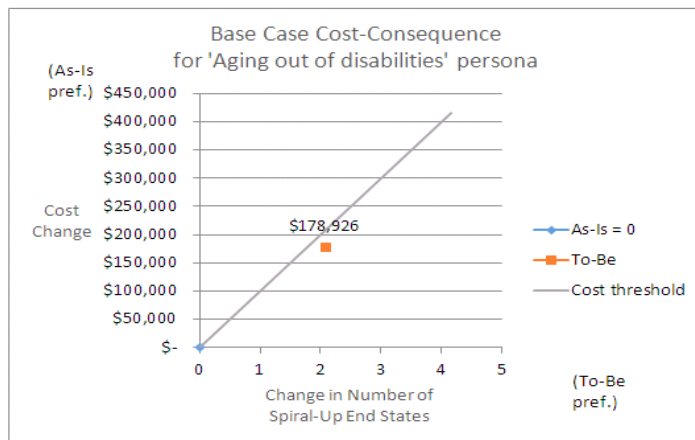
Because the expected investment difference is negative, To-Be is expected to cost \$16,920 less than As-Is. The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is. To-Be is expected to cost \$8,147 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to client. The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to client.

Figure 4.2- Cost-consequence graph of 'Aging out of Foster care'



Because the expected investment difference is positive, To-Be is expected to cost \$3,080 more than As-Is. The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is. To-Be is expected to save \$1,483 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to client. The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to client.

**Figure 4.3- Cost-consequence graph of 'Pregnant Teen'**

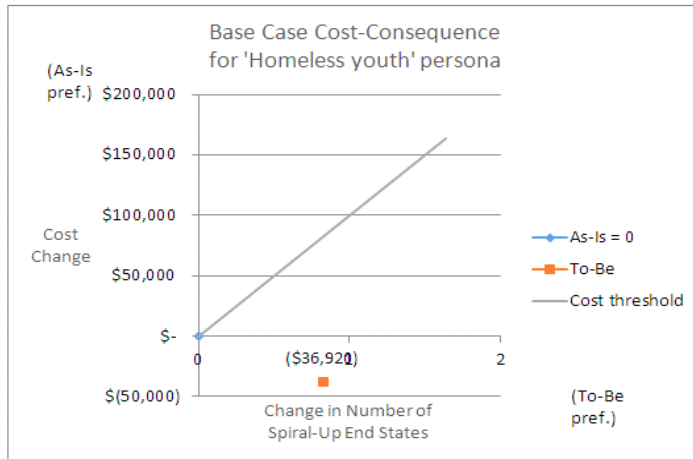


Because the expected investment difference is positive, To-Be is expected to cost \$178,926 more than As-Is. The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is. To-Be is expected to save \$86,150 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to client. The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide less net benefit to client.

**Figure 4.4- Cost-consequence graph of 'Aging out of disabilities'**

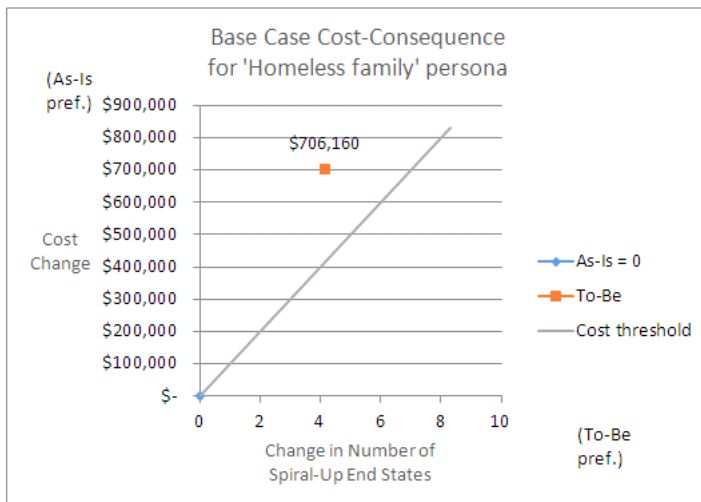
The diagonal line, which runs between the X axis and the Y axis, symbolically represents the maximum Willingness to Pay (WTP) threshold, which in the case of this analysis, as discussed in the assumptions, is pre-set to be \$100,000 per additional client improved. If the square point, which represents the expected To Be results, falls to the right and under the WTP line, To Be is preferred, since the cost per additional client improved is less than WTP amount of \$100,000 per additional client improved. All cost-consequence graphs of the original ICMC with the exception of Figure 4.6 display this situation. In Figure 4.6, however, the To Be square point is to the left and above the

WTP line. This is in harmony with the figure of \$170,001 per additional person improved as displayed under the cost consequence row and homeless family column of Table 4.5.



Because the expected investment difference is negative, To-Be is expected to cost \$36,920 less than As-Is. The number of improved clients ('Spiral Up') is 1 more in To-Be than As-Is. To-Be is expected to cost \$45,124 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to society altogether. The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to society altogether.

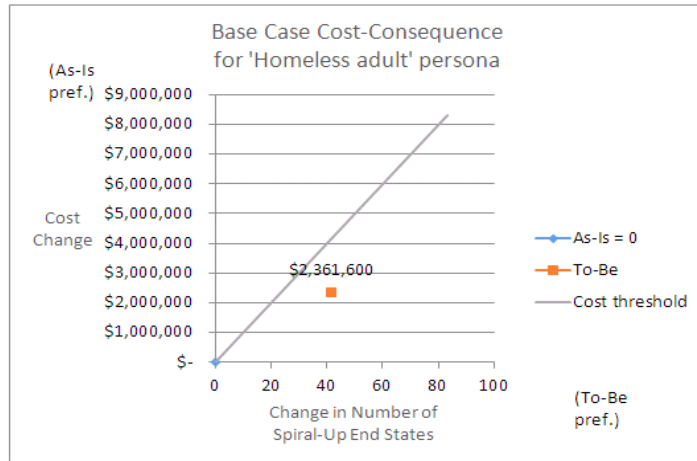
Figure 4.5- Cost-consequence graph of 'Homeless Youth'



Because the expected investment difference is positive, To-Be is expected to cost \$706,160 more than As-Is. The number of improved clients ('Spiral Up') is 4 more in To-Be than As-Is. To-Be is expected to save \$170,002 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is negative, To-Be is expected to confer less value to client. The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide less net benefit to client.

Figure 4.6- Cost-consequence graph of 'Homeless Family'



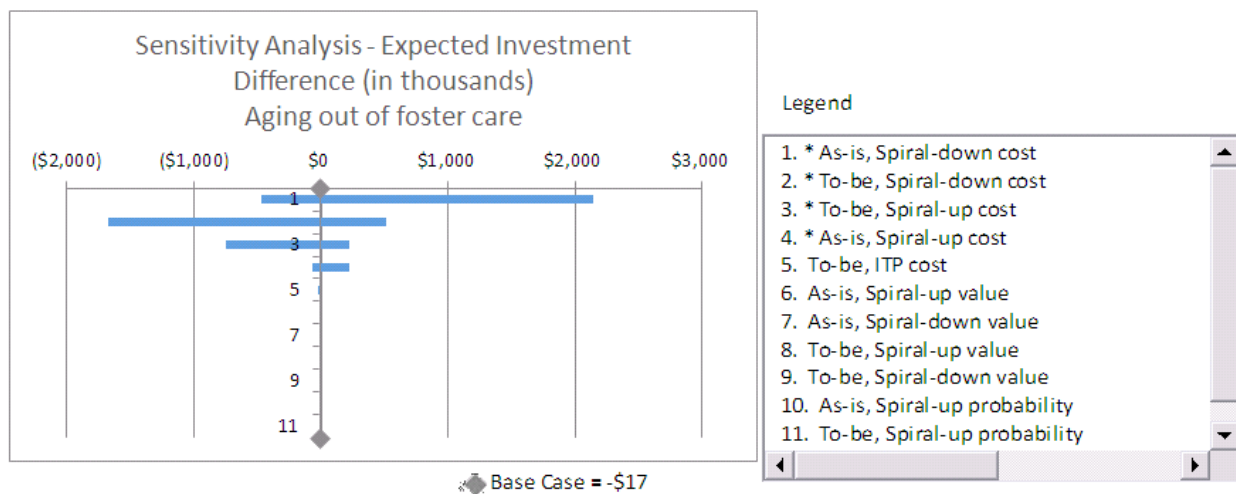


Because the expected investment difference is positive, To-Be is expected to cost \$2,361,600 more than As-Is. The number of improved clients ('Spiral Up') is 42 more in To-Be than As-Is. To-Be is expected to save \$56,853 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to client. The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide less net benefit to client.

Figure 4.7- Cost-consequence graph of 'Homeless adult'

## Sensitivity analysis results

The costs, values, and their ratios displayed in Table 4.6 through Table 4.10 present the point estimate of the entity they represent, and hence their explanation displayed in these tables is for the base case. However, given their probabilistic nature, these estimates are subject to variation. The variation in the investment costs for three personas is displayed as a Tornado Diagram in Figure 4.8, Figure 4.9, and Figure 4.10. Schematically named, a Tornado Diagram is a diagram in which parameters that are subject to variation are displayed in lines that are stacked above one another. The order in which the stacking takes place is such that the parameters that cause the greatest variability in the outcome are on top.



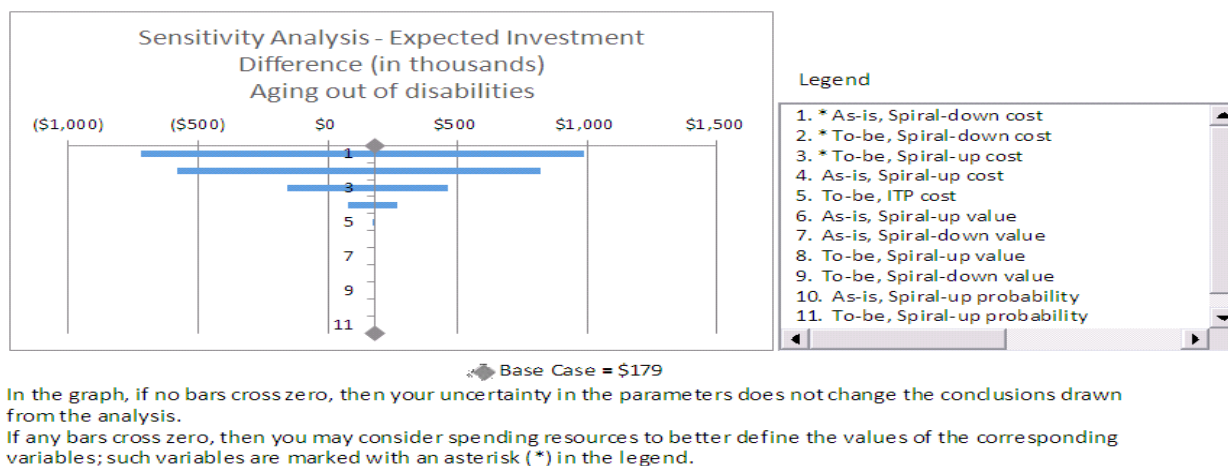
In the graph, if no bars cross zero, then your uncertainty in the parameters does not change the conclusions drawn from the analysis.

If any bars cross zero, then you may consider spending resources to better define the values of the corresponding variables; such variables are marked with an asterisk (\*) in the legend.

**Figure 4.8- Sensitivity analysis of Investment costs for the Aging out of Foster Care (original ICMC)**

Figure 4.8 displays the point estimate of the base case as approximately a divestment of \$17,000. However, this amount can vary from an investment of over \$2 million to a divestment of \$1.5 million. As shown by the asterisks (\*) in the legend of Figure 4.8, this variation is driven by four parameters which are the cost of Spiral Up and Spiral Down, both under As Is and To Be.

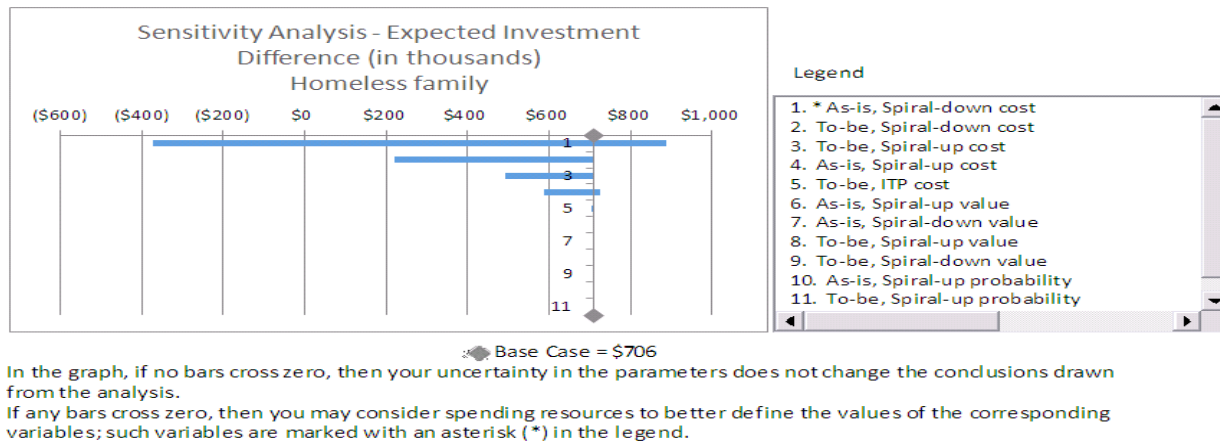
More specifically, the cost of Spiral Up under As Is has the potential to drive the Investment costs to 100 times of the baseline investment, up to over \$2 million.



**Figure 4.9- Sensitivity analysis of Investment costs for the Aging out of disabilities**

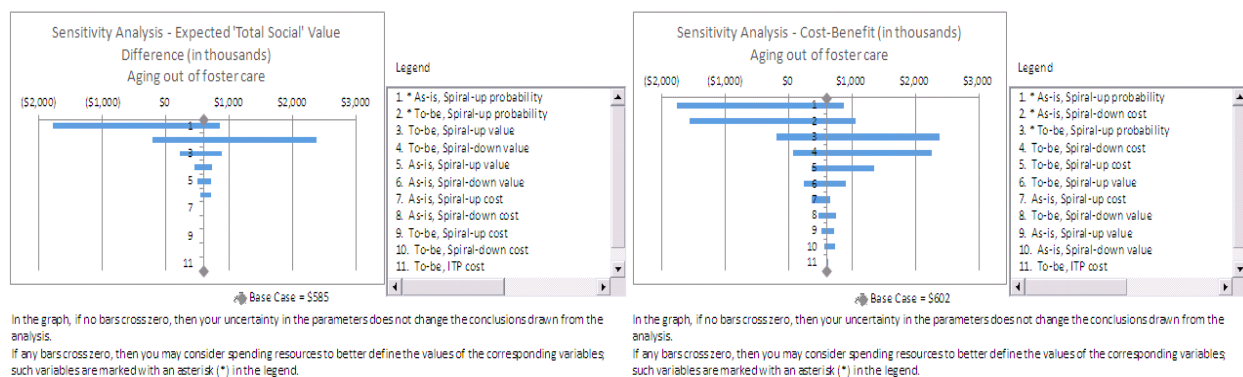
As displayed in Figure 4.9, for the Aging out of disabilities persona, the point estimate of the base case investment cost is approximately an investment of \$179,000. However, as seen this amount can vary from an investment of \$1 million to a divestment of \$0.5 million. As shown by the asterisk in the legend of Figure 4.9, this variation is driven by three parameters which are the cost of Spiral Down, both under As Is and To Be and the cost of Spiral Up under To Be. More specifically the cost of Spiral Down under As Is has the potential to drive the Investment costs to ten times the baseline amount, up to under \$1 million.

In the case of the homeless family, as explained earlier for Figure 4.7, the cost-consequence of \$170,000 per person was above the WTP limit, and at first glance made the investment too expensive. However, as displayed in Figure 4.10, the point estimate of the investment base case is almost entirely driven by the As Is Spiral Down cost. This amount can vary from an investment of \$900,000 to a divestment of \$400,000, and in the case of the lower numbers, change the investment costs to well below the acceptable WTP.

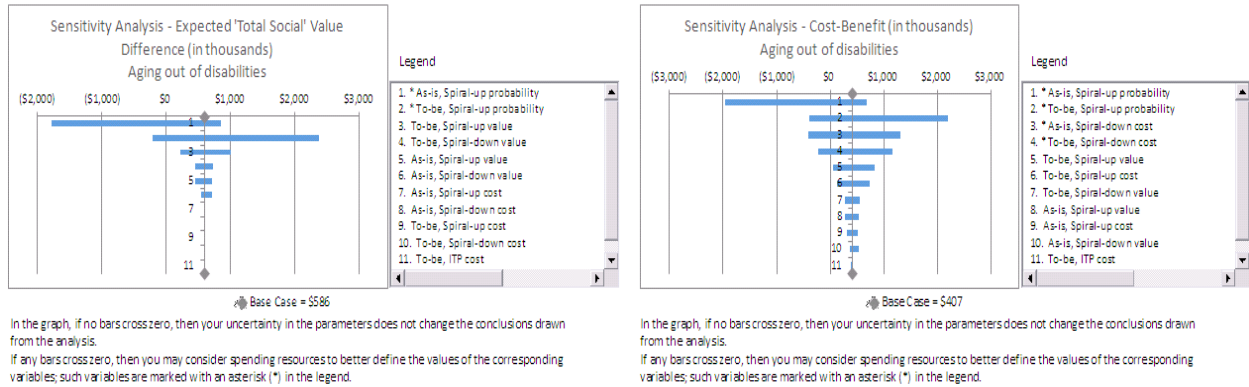


**Figure 4.10- Sensitivity analysis of Investment costs for the Homeless Family**

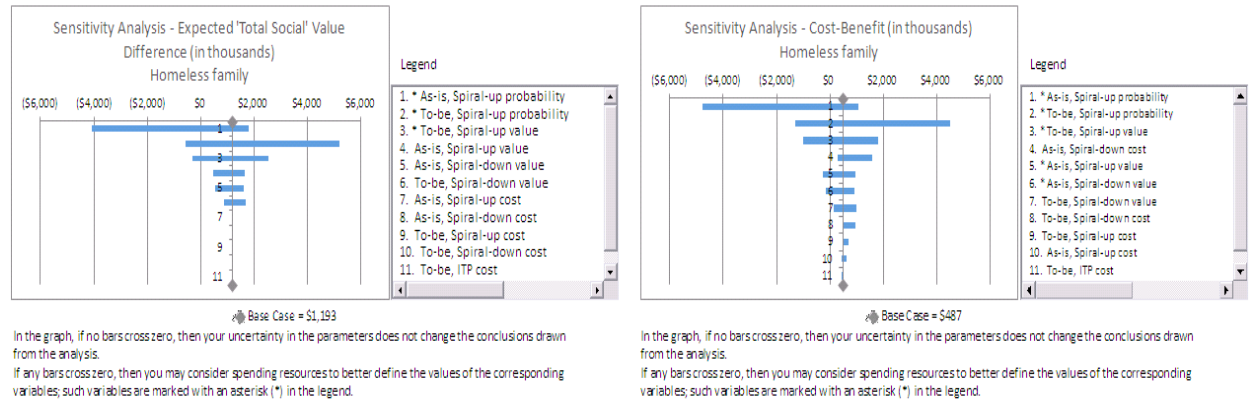
The sensitivity analysis function of the ICMC is not limited to the costs, but also covers the benefits. As figures Figure 4.11 through Figure 4.13 show, both the Total Social value and the Cost-Benefit are subject to large variations which may drive the value of the overall investment towards negative amounts.



**Figure 4.11- Sensitivity analysis of Total Social Value and Net Benefit for Aging out of Foster Care**



**Figure 4.12- Sensitivity analysis of Total Social Value and Net Benefit for Aging out of Disabilities**



**Figure 4.13- Sensitivity analysis of Total Social Value and Net Benefit for Homeless Family**

## Conclusion

The base-case analysis shows that, with the exception of the Aging out of foster care persona, for all personas the costs of an investment in interoperability are greater than the costs of not investing in interoperability. The results also revealed that the expected benefits of implementing interoperability exceed the expected costs. Furthermore, beside the Homeless Family persona, the cost of implementing interoperability is below the Willingness to Pay (WTP) threshold of \$100,000 per client improved. All of this evidence suggests that an investment in interoperability is a prudent move in this case. However, the sensitivity analysis revealed broad ranges for the estimation of costs by magnitudes of 10 or 100 times of the baseline value, many of which exceeded the WTP. The sensitivity analyses also showed that, in each scenario, uncertainty in only one or two parameters would change the model's conclusion regarding the value of interoperability. In real practice, the next step would be to perform client-based data collection to get more accurate estimates of those most sensitive parameters. Identifying which parameters would require such effort is the exact purpose of this entire modeling exercise. Delivering exact estimates is beyond the scope of the current project.

In the next chapter, the discussion will focus on studying the robustness of the ICMC. This is done through modifying the ICMC to be able to accommodate an additional persona (Victim of Domestic Violence), as well as a comparison of the results of this chapter, and the modified ICMC developed in Chapter 5.

## Chapter 5 - ICMC Model Verification

### Background

In the last part of the previous chapter, the sensitivity analysis results revealed the known uncertainties of the ICMC point estimate results. This chapter assesses the robustness of the ICMC calculator to accommodate new scenarios. In this case, “robustness” means: (1) values calculated for other scenarios do not change; (2) issues relevant to decision makers in the new scenario are represented adequately; and (3) the results meet face validity.

This chapter describes the efforts made to test whether and how the ICMC can be retrofitted to other personas, using the construct of “Study of effects” (Friedman, 1995, 2013), which was introduced in Chapter 1.

## **Objective**

As noted in Chapter 1, this Chapter focuses on the fourth specific aim, which is to test the robustness of the computer-based SROI model in accommodating varied personas. The research question related to this aim is whether the computer-based SROI model is robust to accommodate additional personas other than the six original personas., and withstand tests of face validity and retrofitting. In doing so, this Chapter develops a new persona, and repeats the methods of Chapter 3 for the additional persona and compares results with the original.



## Conceptual framework

The conceptual framework of this chapter is the ‘Tower of Achievement’ presented in Chapter 1 (Figure 1.1) and repeated in Figure 5.1 for clarity (Friedman, 2013). The verification and retrofitting of ICMC relates to the ‘study of effects’ construct of the ‘Tower of Achievement’.

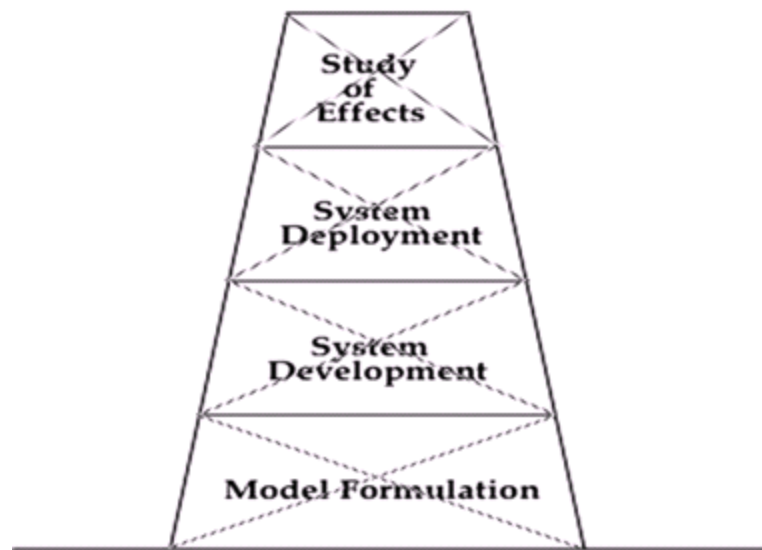


Figure 5.1- Repeat display of the Tower of Achievement (Friedman, 2013)

One of five types of validity that Eddy and colleagues (2012) discuss along with four other type of validity is face validity and they argue that “each type of validation has methods, strengths, limitations, and best practices” (Eddy, et al., 2012):

***Face validity is the extent to which a model, its assumptions, and applications correspond to current science and evidence, as judged by people who have expertise in the problem (Eddy, et al., 2012).***

As part of the study of effects, this chapter discusses the robustness and face validity as they apply to the ICMC..

## **Development of a modified ICMC**

Robustness is defined as “the ability of a system to resist change without adapting its initial stable configuration” (Wieland, 2012). The design of the original ICMC was limited to the six personas discussed in Chapter 3 and outlined in Table 3.1. While the conditions of the six personas are conditions that are prevalent across the United States (the target population of the model), the distribution of conditions that may benefit from interopeability is not homogeneous throughout the country. There may be jurisdictions in which other conditions beside the given personas are of higher priortiy, and therefore local health planning leaders may need to customize the ICMC to accommodate new personas. In order to test the ability of the ICMC in accomodating personas beyond those it was originaly developed for, a new persona needs to be developed.

The persona chosen to test the ICMC is the persona of a victim of domestic abuse. This persona replaces the persona of a child aging out of foster care, due to the similarities that the cost structure of a child aging out of foster care and a child aging out of disabilities had with each other. In order to avoid confusion with the original ICMC, presented in Chapter 3, the ICMC that includes the domestic violence persona is hereafter addressed as the modified ICMC.

## Assumptions

Similar to the original ICMC, the modeling of the modified ICMC process is guided by a series of principal assumptions that are referenced in analytic decision support models for health technology assessments (Philips, et al., 2004). To avoid redundancy the discussion is limited to the assumptions that are different from the original ICMC:

## Setting

As shown by the arrow in Figure 5.2, the main point of entry into services by the abused client is the 'Partner Abuse' division under the Behavioral Health and Crisis Services service area of MC DHHS.

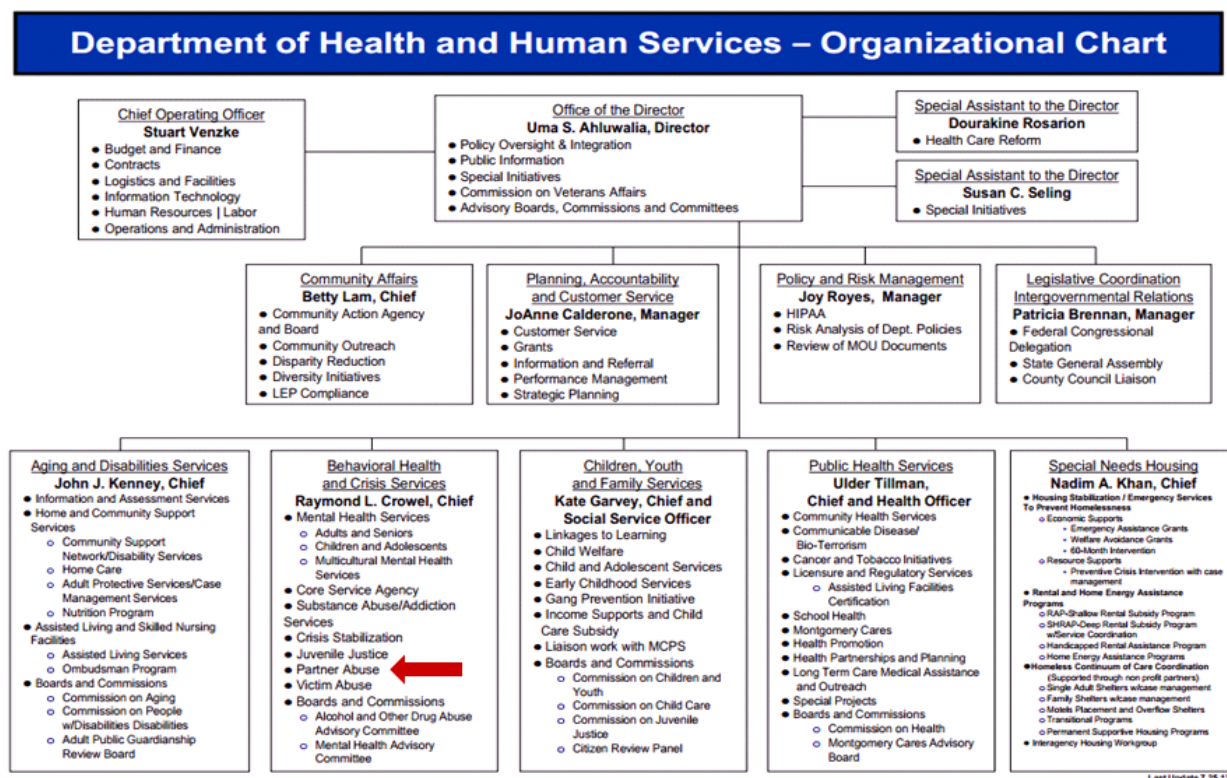


Figure 5.2- Position of Partner Abuse services within MC DHHS

The clients of the Partner Abuse division are primarily referred to the division through a crisis hotline (MC DHHS, 2014a) or occasionally law enforcement authorities. Through contractual agreements with MC DHHS the clients are primarily housed at Betty Ann Krahne (BAK) center (Family Services Inc., 2014). The BAK center describes itself as:

***“the only emergency domestic violence shelter for women and children in Montgomery County, MD. BAK is a 54-bed, short-term crisis shelter for women and children who are fleeing domestic violence and/or victims of sexual assault or human trafficking. BAK provides crisis intervention, safety planning, victim advocacy services, counseling and therapeutic interpersonal skill-building, with an emphasis on trauma reduction and personal empowerment” (Family Services Inc., 2014).***

Between July 1<sup>st</sup>, 2012 and June 30<sup>th</sup>, 2013 the BAK center admitted a total of 127 female clients and 2 male clients. Of this group, 21 of the clients were 18 to 24 years, and the remaining 106 were between 25 and 59. The contractual agreement between BAK and MC DHHS for the same year was approximately \$1 million (exact prices subject to NDA)(MC DHHS, 2014b). The maximum stay of clients at the BAK was 90 days (MC DHHS, 2014b). For the period between July 1<sup>st</sup>, 2013 and June 30<sup>th</sup>, 2014 a total of 59 clients were referred by the Partner Abuse division to BAK (MC DHHS, 2014b).

### ***Target population***

The target population of the interoperability intervention is the clients of DHHS. The target sample, however, for model verification is the victim of domestic violence client of MC DHHS. The reason behind selecting a different persona is that the testing of the adaptability of the ICMC to personas other than the one used in the original ICMC would have been meaningless if the original personas were used. The MC DHHS leadership suggested the use of the victim of domestic abuse persona as the alternate persona for three reasons:

- 1- Domestic abuse victims are the next highest users of MC DHHS services and therefore next highest cost users of MC DHHS.
- 2- Currently under As Is domestic abuse cases are only detected through the specialized abused persons division. Under the interoperability 'no wrong door policy' of To Be, all divisions should be able to detect such cases.
- 3- The prevalence of domestic abuse is high throughout the United States and there could be jurisdictions in which domestic abuse cases are among those who would benefit the most from interoperability.

### ***Alternatives***

Same as the original ICMC

### ***Outcomes***

Same as the original ICMC

### ***Uncertainties and Probabilities***

Same as the original ICMC

### ***Structure***

Same as the original ICMC

### ***Perspectives***

The perspectives this SROI study considers are of multiple stakeholders and include the Client, Social Direct, and Social Indirect perspectives. In the Client perspective, the costs and benefits the domestic violence client endures are calculated. In the Social Direct (Direct) perspective, the costs and benefits the government (in this case MC DHHS) endures are calculated. In the Social Indirect perspective, all other costs (or reduction of costs) that stakeholders other than

the client or government endure are calculated. In the case of this study, the stakeholders, other than the client or government, are members of the victim's nuclear family, more specifically the client's children, and spouse.

***Time***

Same as the original ICMC

***Desires and Tradeoffs***

Same as the original ICMC

**Protection of human subjects**

This study was a continuation of the development of the original ICMC and follows the same human subjects protection protocol.

## Methods

The method of developing the modified ICMC is a replica of the methods used to develop the original ICMC. Similar to the original ICMC, a SROI model estimates the costs and consequences of delivering human services under two conditions: As Is (pre interoperability) and To Be (post interoperability). The Cresswell et al (2006) model guides the design of the stages of this study. These stages in sequential order include:

1. Literature review – Explained in the ‘Literature review’ section.
2. Caseworker interviews – Explained in ‘Persona’ section
3. Persona development – Explained in ‘Persona’ section
4. Persona validation – Explained in ‘Persona’ section
5. Mapping the persona conditions to services and outcomes – Explained under the ‘Mapping and valuation of outcomes’ and ‘Analytical approach’ section.
6. Assigning cost values to services and outcomes – Explained under the ‘Analytical approach Cost Values’ section.
7. Assigning probabilities to probabilistic values of services and outcomes – Explained under the ‘Analytical approach’ section.
8. Running the ICMC calculator and obtaining point estimates for the costs and outcomes from the client, social direct, and social indirect perspectives – Explained under the ‘Analytical approach’ section.
9. Running the ICMC calculator and obtaining point estimate and sensitivity analysis results – Explained under the ‘Results’ section.
10. The reporting and discussion of the results – Explained under the ‘Results’ section and continued in next Chapter under discussion.

## **1. Literature Review**

The objective of the literature review was for the author to become familiar and with cases of domestic violence. Therefore, literature review was thorough but not as comprehensive as a systematic review of case reports of domestic violence since it was limited to the PubMed database and did not include other databases. Under the PubMed setting the search used Medical Subject Headings (MeSH) terms in the following search algorithm:

“Case Reports”[Publication Type] AND (“Domestic Violence”[MeSH] OR “Spouse Abuse”[MeSH]) AND (“2004/01/01”[PDAT] : “3000/12/31”[PDAT]) AND “humans”[MeSH Terms] AND English[lang]”

The PubMed search for case reports on victims of domestic violence resulted in 709 articles; which after title and abstract review 22 were selected for full text review. These 22 case reports of victims of domestic violence retrieved from the PubMed search were reviewed (Berkowitz, 2008; Bird, 2011; Biswas, Malhotra, Rana, & Shetty, 2004; Booher, Lane, & Davis, 2004; Brickner, 2013; Buckler & Bernhard, 2013; Calloway, 2011; Collado & Levine, 2007; Everson & Faller, 2012; Faller & Everson, 2012; Jackson, et al., 2007; Jenkin & Millward, 2006; Kerig, Sink, Cuellar, Vanderzee, & Elfstrom, 2010; Levendosky, Lannert, & Yalch, 2012; Liang, Goodman, Tummala-Narra, & Weintraub, 2005; Musser & Murphy, 2009; Scott-Tilley, Tilton, & Sandel, 2009; Shay-Zapien & Bullock, 2010; Shengold, 2011; Uypitching, 2009; Waldron, 2010; Wijma, Thapar-Bjorkert, Hammarstrom, & Swahnberg, 2007). All of the reviewed literature revealed stories and comprehensive case reports of domestic violence patients who had either suffered from physical or psychological trauma that was so severe that the patient’s conditions required medical care in a clinical setting.



## ***Persona***

Unlike the personas of the original ICMC, which MC DHHS had developed a priori, the persona for this study needed to be developed. The heart of this testing is developing the persona within the bounds set by the original ICMC. To develop the persona, the author interviewed caseworkers and managers of the Abused Persons division, drafted the persona, and validated the persona with caseworkers and managers. The interviews with the MC DHHS personnel from the division of Abused Persons took place over two sessions, which each lasted two hours. MC DHHS staff participated in the first interview with the objective of persona development. The interview focused on the question of describing the conditions of the most common type of client a caseworker would work with on a daily basis. The staff participated in a second interview with the objective to inform the service delivery function of the Abused Persons division. In this interview the question focused on the types of services the client would receive and what were the current outcomes of those services under As Is (with no interoperability), and how the caseworker predicted the outcomes would be under the To Be conditions with interoperability and eICM. The persona description was then drafted and modified based on two draft exchanges and comments by caseworkers and Service Area managers. Text Box 1 displays the finalized persona.

**Text Box 1- The persona of victim of domestic abuse final text, based on critique by Abused Persons Division staff.**

Laura Maria is a 25 year aged married woman with two children, Daniel (male/ 2 years age) and Isabel (female/ 8 years age). Along with her two children, she was admitted to the Betty Ann Krahne Center (BAK), a shelter for female victims of domestic violence and their children, for the first time in September 2013. Her first stay at BAK followed an investigation of the Montgomery County Police Department into a noise complaint from her neighbors. The police deemed that it was not safe for Laura and her children to stay in their home due to suspicion of domestic violence. Her first stay at the shelter was 8 days. During that time, she informed the shelter staff that while she was born in Belize she had arrived in the United States at the age of 14 with her mother, and had tried to enroll in a Montgomery County high school upon settlement. In high school, she became pregnant with her first daughter when she was 16 years of age from her former partner. After giving birth, continuing school became increasingly difficult, so she decided to take on a minimum wage job, and by 18 she had lost her hopes of attaining her GED. Life became more difficult for her when her mother had to return to Belize for a family emergency when Laura was 21 years of age. Soon after, she decided to marry her current husband, Oscar. Oscar is a male and currently is 27 years of age and was 23 years of age at the time of marriage. Oscar and Laura met as coworkers at a common job. A year after her marriage, she became pregnant and gave birth to her son Daniel. Ten days after her first stay at the BAK she returned back to her home, when she and her husband agreed to attend counselling sessions with a family therapist introduced to her by the BAK staff.

In late November 2013, Laura was admitted to the BAK center in more dire conditions. This time she herself had called the crisis hotline of the BAK center and after she arrived with her two children, it was noticed that she had visible bruising and scars. At first, Laura downplayed her husband's attack claiming that he had not meant to hurt her and that she had tripped over the couch during the altercation, and reported her injuries were from work. However, she felt safer to stay at the shelter, due to her husband's bad temper. Her daughter, Isabel, confided to a social worker that her mother had been beaten. Laura also mentioned that she was considering finding a new home to stay as soon as she could find one that she could afford. She reported to the social worker that she had visited the family therapist for one session of counselling, but had not found the counsellors advice to be useful. She later admitted to her social worker that she had not been able to find work since August, and that her husband had difficulty finding a permanent job. The social worker reports that she seems more timid, more lethargic, and less talkative since they first met in

September. The social worker also suspects that Laura has a case of learned paralysis, if not PTSD, or perhaps even depression.

During the months of December and January, Isabel has continued to attend school. Laura has had multiple counselling sessions with individual social workers, has met with her husband once, but still does not feel safe to go back home. She was terrified of not being able to provide care for her children and of the prospect of them going back to Oscar, or in the case of a court decision, that they may be sent to foster care under the custody of child services. She spends most of her days looking for both a place to live, and a job. Her conditions qualified her for an intensive team planning effort with the participation of the following:

1. A social worker from the BAK center.
2. A case manager from the Abused Persons Program.
3. A representative from the Special Needs Housing division.
4. A representative from Children's Welfare.
5. A representative from the Arbor foundation.

This meeting resulted in the following agreed upon plan:

- Laura was assured that the two young children would not be taken from her into foster care, but would remain with their mother. Child Welfare was to meet with Laura next week to follow up on the case.
- Laura will receive assistance from the county housing and homeless services to be considered for special consideration for subsidized housing.
- Laura will receive professional mental health evaluation and psychiatric services.
- Laura would be enrolled in the Temporary Cash Assistance (TCA) program as she pursues her GED and job training at the Arbor Foundations.
- Arbor foundation would provide daycare for Daniel during the times that Laura is pursuing her education, training, or is working.

The meeting resulted in the children remaining with their mother and the family working to overcome their challenges. Multiple supports and services were put in place. Laura, however, feels quite anxious since she has been informed that her maximum stay of 75 days at the BAK is about to end soon, and she has still been unable to find alternative housing. She knows that she has difficult decisions to make.

## 5. Mapping persona conditions to services and outcomes

The first step in mapping the persona was to determine which parts of the persona could be modeled into the ICMC. It could not automatically be assumed that all aspects of the new persona are adoptable to the ICMC since the social workers who informed the development of the victim of domestic violence persona were chosen so they had no prior familiarity with the ICMC. This selection was done to mimic other jurisdictions in which the ICMC may be used the first time. Text Box 2 demonstrates the qualitative method used to determine which parts of the persona the ICMC covers. The left hand column of Text Box 2 is a copy of the persona text in order of relevancy to the ICMC, with points covered by the ICMC coming first, followed by points not covered by the ICMC, and points that are irrelevant to the ICMC. The right hand column of Text Box 2 demonstrates which segments of the ICMC cover the point.

**Text Box 2- Mapping the persona of victim of domestic abuse.**

Persona	Coverage by the ICMC
Laura Maria is a 25 year aged married woman with two children, Daniel (male/ 2 years age) and Isabel (female/ 8 years age). In high school, she became pregnant with her first daughter when she was 16 years of age from her former partner. Soon after [21], she decided to marry her current husband, Oscar. Oscar is a male and currently has 27 years age and was 23 years age at the time of marriage. A year after her marriage, she became pregnant and gave birth to her son Daniel.	The ICMC does have the ability to cover time for both the mother (direct) the children, and the spouse.
Along with her two children, she was admitted to the Betty Ann Krahne Center (BAK), a shelter for female victims of domestic violence and their children, for the first time in September 2013. Her first stay at the shelter was 8 days. Laura, however, feels quite anxious since she has been informed that her maximum stay of 75 days at the BAK is about to end soon,	The ICMC does cover the costs of BAK shelter
In high school, she became pregnant with her first daughter when she was 16 years of age from her former partner.	The ICMC does cover costs of teenage pregnancy
and by 18 she had lost her hopes of attaining her GED.	The ICMC does cover the cost of a GED

<b>Persona</b>	<b>Coverage by the ICMC</b>
so she decided to take on a minimum wage job,	The ICMC does cover minimum wage jobs
<p>Ten days after her first stay at the BAK she returned back to her home, when she and her husband agreed to attend counselling sessions with a family therapist introduced to her by the BAK staff.</p> <p>She reported to the social worker that she had visited the family therapist for one session of counselling, but had not found the counselors advice to be useful.</p> <ul style="list-style-type: none"> <li>Laura will receive professional mental health evaluation and psychiatric services.</li> </ul> <p>has met with her husband once, but still does not feel safe to go back home.</p>	The ICMC does cover the cost of psychological counselling and mental health services for the victim and spouse
In late November 2013, Laura was admitted to the BAK center in more dire conditions. This time she herself had called the crisis hotline of the BAK center and after she arrived with her two children, it was noticed that she had visible bruising and scars.	The ICMC does cover the cost of emergency medical care
Laura also mentioned that she was considering finding a new home to stay as soon as she could find one that she could afford.	The ICMC does cover the cost of housing
She later admitted to her social worker that she had not been able to find work since August, and that her husband had difficulty finding a permanent job.	The ICMC does cover the full time work
Laura has had multiple counselling sessions with individual social workers	The ICMC does cover the cost of social worker counselling
or in the case of a court decision, that they may be sent to foster care under the custody of child services.	The ICMC does cover foster care costs
<p>Her conditions qualified her for an intensive team planning effort with the participation of the following:</p> <ul style="list-style-type: none"> <li>A social worker from the BAK center.</li> <li>A case manager from the Abused Persons Program.</li> <li>A representative from the Special Needs Housing division.</li> <li>A representative from Children's Welfare.</li> <li>A representative from the Arbor foundation.</li> </ul>	The ICMC does cover the costs of intensive team planning (ITP)
<ul style="list-style-type: none"> <li>Laura was assured that the two young children would not be taken from her into foster care, but would remain with their mother. Child Welfare was to meet with Laura next week to follow up on the case.</li> </ul>	The ICMC does cover Child Welfare
<ul style="list-style-type: none"> <li>Laura will receive assistance from the county housing and homeless services to be considered for special consideration for subsidized housing.</li> </ul>	The ICMC does cover subsidized housing

Persona	Coverage by the ICMC
<ul style="list-style-type: none"> <li>Laura would be enrolled in the Temporary Cash Assistance (TCA) program</li> </ul>	The ICMC does cover TCA
<ul style="list-style-type: none"> <li>as she pursues her GED and job training at the Arbor Foundations.</li> </ul>	The ICMC does cover the cost of education and job training
<ul style="list-style-type: none"> <li>Arbor foundation would provide daycare for Daniel during the times that Laura is pursuing her education, training, or is working.</li> </ul>	The ICMC does cover the cost of daycare
Multiple supports and services were put in place.	The ICMC does cover Medicaid, Medicaid SCHIP, WIC, and TANF
Her first stay at BAK followed an investigation of the Montgomery County Police Department into a noise complaint from her neighbors. The police deemed that it was not safe for Laura and her children to stay in their home due to suspicion of domestic violence.	The ICMC does not cover the costs of Montgomery County Police Department.
After giving birth, continuing school became increasingly difficult,	The ICMC does not address high school dropout causes
She was terrified of not being able to provide care for her children and of the prospect of them going back to Oscar, or in the case of a court decision, that they may be sent to foster care under the custody of child services.	The ICMC does not cover court costs
The social worker reports that she seems more timid, more lethargic, and less talkative since they first met in September. The social worker also suspects that Laura has a case of learned paralysis, if not PTSD, or perhaps even depression.	The ICMC does not cover the burden of mental illness
<p>During that time, she informed the shelter staff that while she was born in Belize she had arrived in the United States at the age of 14 with her mother, and had tried to enroll in a Montgomery County high school upon settlement.</p> <p>Life became more difficult for her when her mother had to return to Belize for a family emergency</p>	The ICMC does not cover additional burden of immigration status.
<p>At first, Laura downplayed her husband's attack claiming that he had not meant to hurt her and that she had tripped over the couch during the altercation, and reported her injuries were from work. However, she felt safer to stay at the shelter, due to her husband's bad temper. Her daughter, Isabel, confided to a social worker that her mother had been beaten. She spends most of her days looking for both a place to live, and a job. This meeting resulted in the following agreed upon plan:</p> <p>The meeting resulted in the children remaining with their mother and the family working to overcome their challenges. and she has still been unable to find alternative housing. She knows that she has difficult decisions to make.</p>	Not relevant to the ICMC

The next step in mapping this persona is to determine those outcomes that could be mapped to the ICMC. Table 5.1 demonstrates the outcomes for this persona under Spiral Up and Spiral Down conditions. The persona presented in Text Box 1 and analyzed in Text Box 2 are the basis of the information in Table 5.1. However, as mentioned in Text Box 2, the ICMC does not cover non-human services aspects of the persona such as the costs and benefits of law enforcement and immigration enforcement. The ICMC also does not thoroughly delve into the details of the burden of mental illness. Chapter 6 provides a discussion of the points the ICMC does not cover.

**Table 5.1- Summary outcomes for a victim of domestic abuse**

<b>Client group represented</b>	<b>Persona Summary</b>	<b>Spiral Up</b>	<b>Spiral Down</b>
Victim of Domestic Violence	25-year-old mother with two children, residing in a victims shelter, no income, probability of mental trauma	Housed Has achieved her GED Has a full time permanent job Is receiving maintenance mental healthcare No children in foster care	Homeless or forced back to reside with abusive spouse No GED Part time min wage job

After mapping the outcomes, the value difference between the Spiral Up and the Spiral Down is the value of interoperability. However, value also depends on perspective. In the case of the family in this persona, the main client is the mother and there are two other groups of clients including the children and the spouse. The value of services each client receives is also different according the three perspectives, which include the perspective of the client, a social direct perspective of MC DHHS and a social indirect perspective. Since the main client is the mother, the social indirect value would be the value of the services provided to the spouse or to the children, or other costs to society. Table 5.2 provides the client and direct valuation; Table 5.3, and Table 5.4 provide the valuations for the children and spouse.

**Table 5.2- Valuation of Interoperable services for the mother**

<b>Value of Interoperable services for the mother:</b>	<b>Client Perspective</b>	<b>Valuation of Client Perspective</b>	<b>Social Direct Perspective</b>	<b>Valuation of Social Direct Perspective</b>	<b>Social Indirect Perspective</b>	<b>Valuation Social Indirect Perspective</b>
Housing	Would help the mother find independent and less abusive housing.	Cost avoidance: $P(\text{abuse}) \times c(\text{abuse: psych, physical}) + (\text{?abuse as risk factor or any other disease})$ ;	Has negative value since county will be paying for independent housing subsidy.	Cost avoidance: (Family) shelter, Emergency shelter; Deadweight: Cost of independent housing subsidy.	What about the spouse and Children?	
Education	Less violent dwellings may lead to better educational attainment. Educational achievement builds self-esteem and helps find a better job.		Cost of obtaining a GED	Deadweight: Cost of GED	Better informed citizenry. What about the kids?	Dead-weight: Cost of GED
Employment	Financial independence. Self-esteem.	Higher Wages				
Access to Healthcare	Improved healthcare including mental healthcare	Fewer missed days from work	Has negative value if Medicaid will be paying for healthcare. Will benefit if recovery from disease leads to employment.	(Deadweight: Cost of Medicaid) + Deadweight: $c(\text{psych treatment}) - \text{Cost of ED Care}$	What about the kids? What about the spouse?	
Permanent Connections	Loses connection to husband. May gain new connections through shelter, education/job training, employment.	Leisure spending probability goes up (dating)				



**Table 5.3- Valuation of Interoperable services for the children**

<b>Value of Interoperable services for the children:</b>	<b>Social Indirect Perspective</b>	<b>Valuation of Social Indirect Perspective</b>
Housing	Similar to mother direct	Dependent on and same housing as mother
Education	Will continue schooling	No difference between As Is and To Be
Employment	State will need to pay for daycare.	Deadweight: Day care (2 yr old), latchkey 8 yr old
Access to Healthcare	Has negative value if Medicaid-SCHIP will be paying for healthcare. Deadweight: SCHIP	Deadweight: SCHIP Deadweight WIC Deadweight Cost Child Welfare Deadweight Cost County Child Care Subsidy Deadweight Cost State Child Care Subsidy
Permanent Connections	Loss of father figure may have negative psychological consequences.	

**Table 5.4- Valuation of Interoperable services for the spouse**

<b>Value of Interoperable services for the spouse:</b>	<b>Social Indirect Perspective</b>	<b>Valuation of Social Indirect Perspective</b>
Housing	May lose house due to loss of income from wife.	
Education		
Employment	May lead to better income due to time now free for building career.	
Access to Healthcare	May also need psychological care	Deadweight: c(psych treatment)
Permanent Connections	Will lose family.	

## **6. Assigning probabilities and values**

### **Outcome parameters**

The main outcome parameters of this study are the change in the values of housing, education, employment, access to healthcare and permanent connections (HEEAP) between Spiral Up and Spiral Down as displayed in Figure 5.3.

### **Input Parameters**

The main input parameter is the cost of implementation of interoperability (To Be as defined by successful implementation and operation of ITP and eICM), compared to the lack of it (As Is) where the cost is zero. This cost was calculated to be a fixed amount of \$308 per client as the Results section in Chapter 4 describes and Table 4.2 calculates.

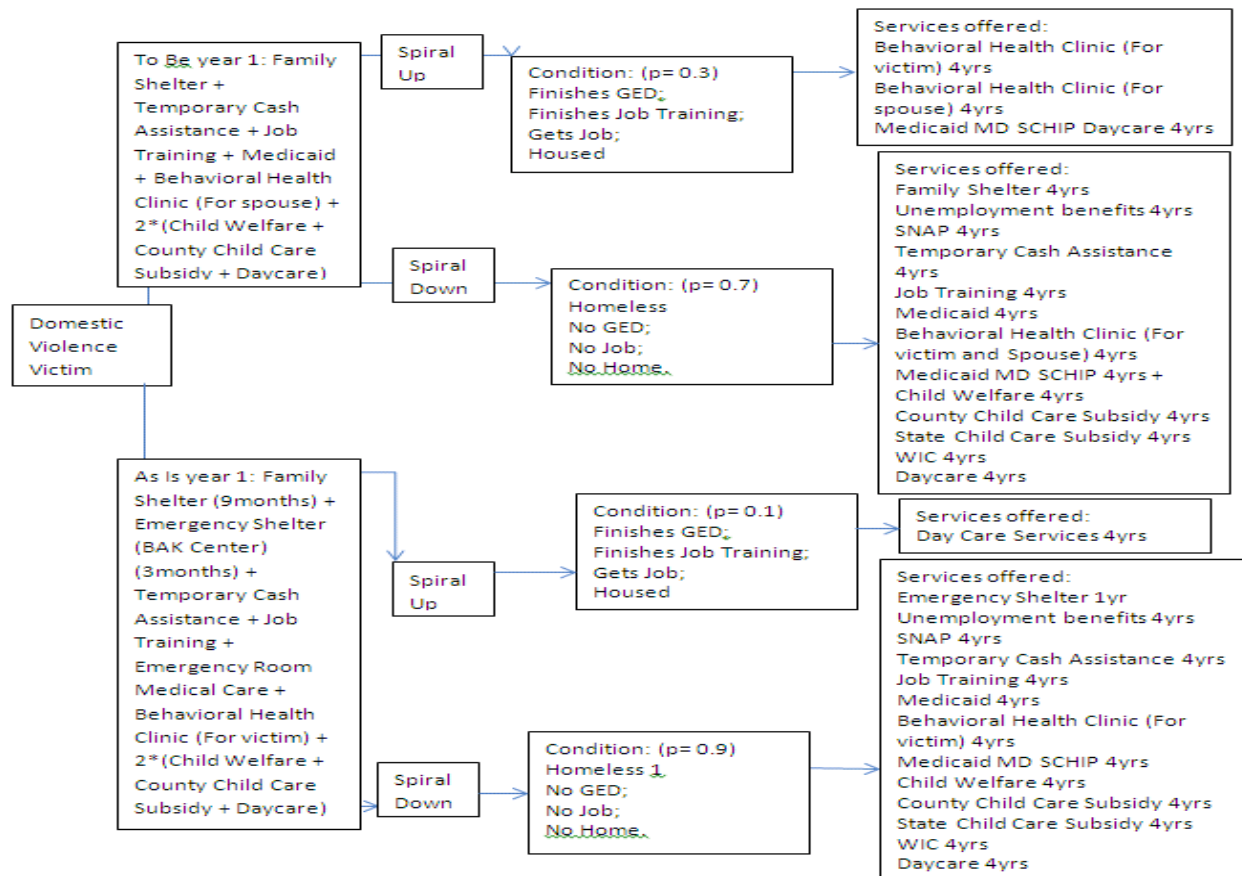
The other input parameter is the value of the service package the clients receive under As Is as well as To Be. As Chapter 3 describes, given that Spiraling Up and/or Spiraling Down can occur under both As Is and To Be, the combinations are:

- Expected Cost of Spiraling Up under As Is
- Expected Cost of Spiraling Up under To Be
- Expected Cost of Spiraling Down under As Is
- Expected Cost of Spiraling Down under To Be

The service package, and the aforementioned value of the service package, the clients receive is different between As Is and To Be and from one persona to another. Since the client persona of a victim of domestic violence is unique and different from the previous personas of Chapter 3, therefore the service package and more importantly the value of the service package is also unique to the persona of a victim of domestic violence. These costs are calculated in the costs parameters section to follow.

## 7. Cost Parameters

Figure 5.3 maps the valuation of the services for the mother, and displays the result of matching the values of Table 5.2 with the original ICMC decision tree framework demonstrated in .



**Figure 5.3- Map of outcomes and services under As Is and To Be**

Table 5.5 and Table 5.6 demonstrate the calculation of the income of the client under Spiral Up and Spiral Down as well as the probability of Spiral Up under As Is and To Be. Table 5.7 lists the relevant costs of services, the sources of where to obtain these data, and the results of obtaining a dollar amount for the values of the mother, children, and the spouse listed respectively in Table 5.2, Table 5.3, and Table 5.4. Once again, out of respect for the confidentiality of MC DHHS data, these Tables do not display some of the exact dollar amounts.

**Table 5.5- Probability of Spiral Up under As Is and To Be**

<b>Name</b>	<b>Value</b>	<b>Low</b>	<b>Hi</b>	<b>Source</b>
Likelihood of Spiraling up, As Is	0.10	0.00	1.00	eSARs
Likelihood of Spiraling up, To Be	0.30	0.00	1.00	eSARs
Odds Ratio of Spiraling Up (To Be/As Is)	3.86	3.00	4.00	Calculated

As Table 5.5, Table 5.6, and Table 5.7 demonstrate, like the development of the original ICMC, three sources provide the data for this segment:

- 1- From literature review of previous studies
- 2- From interviews with MC DHHS staff
- 3- From the Return on Taxpayer Investment (ROTI) study performed by Accenture.

Once again it should be noted that out of respect for the privacy of MCDHHS service cost data some of the cells in Table 5.7 are not revealed.

After these data became available, the ICMC used the data to complete the calculations. The figures represented in Table 5.6 are of special importance, since the difference in income, between Spiral Up and Spiral Down, is what sums up to be most of the value difference experienced from the client perspective. Table 5.9, reveals those values.

**Table 5.6- Annual income of mother under Spiral Up/Down**

<b>Name</b>	<b>Value</b>	<b>Low</b>	<b>Hi</b>	<b>Source</b>
Annual income, Spiral Down	\$7,300	\$0	\$12,500	Based on part time job @ max \$12/hr - \$7/hr - 20 hrs/wk - 52wk/year
Annual income, Spiral Up	\$35,400	\$0	\$41,600	Based on graph of average annual earnings for dropouts, GED, and High School grads. This number is the dropout earnings for a 42 year old (Rouse, 2007).

**Table 5.7- The cost of victim of domestic violence services offered by MC DHHS\***

Client	Name	Value	For Sensitivity Analysis		Source of funds	Source of data
			Lo	Hi		
Victim	Annual Cost Family Shelter	██████	██	██████	County	Informed by ROTI
Victim	Annual Cost of Emergency Shelter (BAK Center)	██████	██████	██████	County	Interview
Victim	Annual housing subsidy, Spiral up	\$ 9,000	\$ 5,000	\$ 12,000	County	Section 8: (Montgomery Fair Market Rent of 1270 - max out of pocket of \$500) * 12 ( <a href="http://average-rent.findthedata.org/1/8329/20904">http://average-rent.findthedata.org/1/8329/20904</a> )
Victim	Annual cost of unemployment benefits	██████	██	██████	Federal	Informed by ROTI
Victim	Annual cost of SNAP	██████	██	██████	Federal	Informed by ROTI
Victim	Annual Cost of Temporary Cash Assistance	██████	██	██████	County	Informed by ROTI
Victim	Annual Cost Job Training (Arbor)	██████	██	██████	County	Informed by ROTI
Victim	Annual Cost of Medicaid	██████	██	██████	State	Informed by ROTI
Victim	Annual Cost Emergency Room Medical Care (2 visits - Max 4 visits)	\$ 8,800	\$ 0	\$ 20,000	County	( <a href="http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0055491">http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0055491</a> )
Victim / Spouse	Annual cost of Behavioral Health Clinic (For victim or spouse)	██████	██	██████	County	Informed by ROTI
Child	Annual Cost Medicaid MD SCHIP	██████	██	██████	State	Informed by ROTI
Child	Annual Cost Child Welfare	██████	██	██████	County	Informed by ROTI
Child	Annual Cost County Child Care Subsidy	██████	██	██████	County	Informed by ROTI
Child	Annual Cost State Child Care Subsidy	██████	██	██████	State	Informed by ROTI
Child	Annual cost of WIC	██████	██	██████	Federal	Informed by ROTI
Child	Annual cost of Childcare	██████	██	██████	State	Informed by ROTI
* The dark boxes contain cost of services, which have been hidden due to confidentiality agreements with MC DHHS						

**Table 5.8- Calculation of bundled costs**

Name	Value	For Sensitivity Analysis	
		Lo	Hi
Cost of As Is bundle year 1	\$37,350	\$720	\$49,550
Cost of To Be bundle year 1	\$43,600	\$0	\$40,600
Annual cost of Spiral Down services	\$68,650	\$1,680	\$71,750
Annual cost of Spiral Up services	\$24,200	\$0	\$25,200

Table 5.8 demonstrates the calculation of bundled costs. The components of these bundled costs are as follows:

**Cost of As Is bundle year 1:**

Annual Cost Family Shelter (9months)

+ Annual Cost of Emergency Shelter (BAK Center) (3months)

+ Annual Cost of Temporary Cash Assistance

+ Annual Cost Job Training (Arbor)

+ Annual Cost Emergency Room Medical Care (2 visits - Max 4 visits) + Annual cost of Behavioral Health Clinic (For victim)

+ 2 x (Annual Cost Child Welfare + Annual Cost County Child Care Subsidy + Annual Cost of Daycare)

**Cost of To Be bundle year 1:**

Annual Cost Family Shelter

+ Annual Cost of Temporary Cash Assistance

+ Annual Cost Job Training (Arbor)

+ Medicaid

+ Annual cost of Behavioral Health Clinic (For spouse)

- + 2 x (Annual Cost Child Welfare
- + Annual Cost County Child Care Subsidy
- + Annual cost of Daycare)

**Annual cost of Spiral Down services:**

- Annual Cost Family Shelter (9months)
- + Annual Cost of Emergency Shelter (BAK Center) (3months)
- + Annual cost of unemployment benefits
- + Annual cost of SNAP
- + Annual Cost of Temporary Cash Assistance
- + Annual Cost Job Training (Arbor)
- + Annual Cost of Medicaid
- + 2 x Annual cost of Behavioral Health Clinic (For victim and spouse)
- + 2 x (Annual Cost Medicaid MD SCHIP + Annual Cost Child Welfare + Annual Cost County Child Care Subsidy + Annual Cost State Child Care Subsidy + Annual cost of WIC + Annual cost of Daycare)

**Annual cost of Spiral Up services:**

- Annual cost of Behavioral Health Clinic (For victim or spouse)
- + 2x (Annual Cost Medicaid MD SCHIP
- + Annual cost of Daycare).

The next step is to separate the value of interoperability for each of the client, direct social and social indirect perspectives. Table 5.9 presents the monetarily quantified values for each of the client, social direct, and social indirect values.

**Table 5.9- Monetary values of permutations of conditions from varied perspectives**

As Is /To Be	Spiral	Value Name	Value	Lo	Hi
As Is	Spiral Up	Client Value	\$141,500	\$0	\$166,500
		Direct Social Value	\$0	\$0	\$0
		Indirect Social Value	\$3,000	\$0	\$4,000
		Combined Value	\$144,500	\$0	\$170,500
	Spiral Down	Client value	\$29,000	\$0	\$50,000
		Direct Social Value	\$106,000	\$0	\$112,000
		Indirect Social Value	\$110,500	\$0	\$117,500
		Combined value	\$246,000	\$0	\$279,500
To Be	Spiral Up	Client Value	\$141,500	\$0	\$166,500
		Direct Social Value	\$35,000	\$0	\$35,000
		Indirect Social Value	\$3,000	\$0	\$4,000
		Total Value	\$180,000	\$0	\$205,500
	Spiral Down	Client value	\$29,000	\$0	\$50,000
		Direct Social Value	\$129,000	\$7,000	\$134,000
		Indirect Social Value	\$145,500	\$0	\$153,000
		Combined value	\$304,000	\$6,500	\$337,000



In calculating the values presented in Table 5.9, for the As Is Spiral Up condition, the client value is the value of income, while there is no social direct value and the social indirect value is the annual cost of daycare for two children. For the As Is Spiral Down, the client value is the value of income. The social direct value is the Annual Cost of Emergency Shelter (3months) added to the Annual cost of unemployment benefits, the Annual cost of SNAP, the Annual Cost of Temporary Cash Assistance, the Annual Cost Job Training, the Annual Cost of Medicaid, and the Annual cost of Behavioral Health Clinic (For victim). The social indirect value for the As Is Spiral Down condition is the Annual Cost Medicaid MD SCHIP added to the Annual Cost Child Welfare, the Annual Cost of the County Child Care Subsidy, the Annual Cost of the State Child Care Subsidy, the Annual cost of WIC and Annual cost of Daycare.

The same Table 5.9 presumes the client value for the To Be Spiral Up condition the value of income. It also derives the direct social value by adding the Annual cost of Behavioral Health Clinic (For victim). It calculates the indirect social value by adding the Annual cost of Behavioral Health Clinic (For spouse), to the Annual cost of Daycare and the Annual Cost Medicaid MD SCHIP.

For the To Be Spiral Down condition, Table 5.9 presumes the client value as the value of income. The social direct value is the Annual Cost of Family Shelter (9months) added to the Annual Cost of Emergency Shelter (3months), the Annual cost of unemployment benefits, the Annual cost of SNAP, the Annual Cost of Temporary Cash Assistance, the Annual Cost Job Training, the Annual Cost of Medicaid, and the Annual cost of Behavioral Health Clinic (For victim). Under the same To Be Spiral Down condition the social indirect value is calculated as the Annual cost of Behavioral Health Clinic (For spouse) added to the Annual Cost Medicaid MD SCHIP, the Annual Cost of Child Welfare, the Annual Cost County Child Care Subsidy, the Annual Cost State Child Care Subsidy, the Annual cost of WIC, and the Annual cost of Daycare.

All the children's costs in Table 5.9 are for two children and hence multiplied by two. Also given the assumption that the first year is for implementation, and four years for changes due to interoperability, the values above represent the total amount for the four years.

Figure 5.4 displays the final parameters derived from Table 5.8 and Table 5.9 for the victim of domestic violence, which the modified ICMC uses.

<b>Persona:</b>		<b>Victim of Domestic Abuse</b>		Willingness-to-pay threshold	
Proportion of population:		108		per spiral-up case:	
				\$ 100,000	
				pSpiralUp Threshold	
Average investment per case	Spiral-up	\$ 37,350	\$ 43,600	2.61	
	Spiral-down	\$ 37,350	\$ 43,600		
	eICM investment		\$ 308		
				Get from worksheet	
Average value per case	Spiral-up	\$ 144,600	\$ 179,800		
	Spiral-down	\$ 246,200	\$ 303,800		
				Go to worksheet	
Probability	Spiral-up	0.10	0.30		
	Spiral-down	"1 - Probability of Spiral-up"			
Threshold for Probability of Spiral-up in To-Be:			0.49		

**Figure 5.4- Parameters of the domestic-violence persona model**

## **Results**

The modified ICMC delivered the results of the model in both text format and in graphical format. These text results were formatted in tables and presented below.

### **Tables**

Table 5.10 through Table 5.14 present the results of the modified ICMC. In Table 5.10, the Total population of the domestic violence victim cohort is 130 persons. The difference in the number of clients expected to Spiral Up under To Be and As Is, is presented as 26 clients. The projected extra costs of the implementation of Interoperability for the total cohort of domestic violence clients, is \$852,540. The resulting cost consequence is a division of the difference in costs by the difference in number of improved clients, which results in \$32,765 per client saved from domestic abuse due to interoperability, beyond who would be saved by As Is.

Table 5.11, Table 5.12, and Table 5.13 display the values of the benefits and net benefits (benefits – investment) from the three perspectives represented in this study. For the domestic violence persona, the expected value difference from the client perspective is \$2,924,673 (Table 5.11), \$637,704 from the social direct perspective (Table 5.12), and \$407,917 from the social indirect perspective (Table 5.13). When each of these figures is subtracted from the investment cost of \$852,540 the result for the client benefit-cost is \$2,072,133 (Table 5.11), social direct benefit-cost is -\$214,836 (Table 5.12), and social indirect benefit-cost is -\$444,623 (Table 5.13).

**Table 5.10- The costs and cost-consequences from the modified ICMC**

	Persona		Victim of Domestic Violence	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Number	Total Client Population		130	10	40	10	20	200
	Difference in number of Spiral-up Cases	(ToBe - AsIs)	26	2	8	1	4	42
	Base Case Interpretation		The number of improved clients ('Spiral Up') is 26 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 2 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 8 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 1 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 4 more in To-Be than As-Is.	The number of improved clients ('Spiral Up') is 42 more in To-Be than As-Is.
Cost	Expected Investment Difference	(ToBe - AsIs)	\$ 852,540	\$ 3,080	\$ 715,704	(\$ 36,920)	\$ 706,160	\$ 2,361,600
	Base Case Interpretation		Because the expected investment difference is positive, To-Be is expected to cost \$852,540 more than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$3,080 more than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$715,704 more than As-Is.	Because the expected investment difference is negative, To-Be is expected to cost \$36,920 less than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$706,160 more than As-Is.	Because the expected investment difference is positive, To-Be is expected to cost \$2,361,600 more than As-Is.
Cost-Consequence	Expected Investment Difference / Difference in number of Spiral-up Cases		\$ 32,765	\$ 1,483	\$ 86,150	(\$ 45,124)	\$ 170,001	\$ 56,853
	Base Case Interpretation		To-Be is expected to cost \$32,765 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$1,483 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$86,150 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to cost \$45,124 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$170,001 for every client helped to 'spiral up,' over what As-Is would have accomplished.	To-Be is expected to save \$56,853 for every client helped to 'spiral up,' over what As-Is would have accomplished.

**Table 5.11- The ‘client’ value and cost-benefit from the modified ICMC**

		Persona	Victim of Domestic Violence	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Client	Expected 'Client' Value Difference (ToBe - AsIs)	\$ 2,924,673	\$ 20,769	\$ 284,677	\$ 21,600	(\$ 16,615)	\$ 1,005,829
		Base Case Interpretation	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$2,924,673 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$20,769 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$284,677 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$21,600 to all clients.	Because the expected value difference is negative, To-Be is expected to confer a less value of \$16,615 to all clients.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$1,005,829 to all clients.
		Cost-Benefit (Expected 'Client' Value Difference - Expected Investment Difference)	\$ 2,072,133	\$ 17,689	(\$ 431,027)	\$ 58,520	(\$ 722,775)	(\$ 1,355,771)
		Base Case Interpretation	The expected difference in value is \$2,072,133 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to the clients.	The expected difference in value is \$17,689 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to the clients.	The expected difference in value is \$431,027 less than the expected cost of investment, so To-Be is expected to provide a net loss to the clients.	The expected difference in value is \$58,520 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to the clients.	The expected difference in value is \$722,775 less than the expected cost of investment, so To-Be is expected to provide a net loss to the clients.	The expected difference in value is \$1,355,771 less than the expected cost of investment, so To-Be is expected to provide a net loss to the clients.

**Table 5.12- The 'direct social' value and cost-benefit from the modified ICMC**

		Persona		Victim of Domestic Violence	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Direct Social Value	Expected 'Direct Social' Value Difference	(ToBe - AsIs)	\$ 637,704	\$ 829,231	\$ 2,060,802	\$ 53,726	\$ 386,782	\$ 12,333,524
		Base Case Interpretation		Because the expected value difference is positive, To-Be is expected to confer a greater value of \$637,704 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$829,231 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$2,060,802 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$53,726 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$386,782 to government agencies.	Because the expected value difference is positive, To-Be is expected to confer a greater value of \$12,333,524 to government agencies.
		Cost-Benefit (Expected 'Direct Social' Value Difference - Expected Investment Difference)		(\$ 214,836)	\$ 826,151	\$ 1,345,098	\$ 90,646	(\$ 319,378)	\$ 9,971,924
		Base Case Interpretation		The expected difference in value is \$214,836 less than the expected cost of investment, so To-Be is expected to provide a net loss to government agencies.	The expected difference in value is \$826,151 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$1,345,098 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$90,646 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.	The expected difference in value is \$319,378 less than the expected cost of investment, so To-Be is expected to provide a net loss to government agencies.	The expected difference in value is \$9,971,924 greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to government agencies.

**Table 5.13- The 'indirect social' value and cost-benefit from the modified ICMC**

		Persona		Victim of Domestic Violence	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Indirect Social Value	Expected 'Indirect Social' Value Difference	(ToBe - AsIs)	\$ 407,917	\$ 219,253	\$ 0	\$ 164,298	\$ 822,528	\$ 485,169
		Base Case Interpretation		Because the expected value difference is positive, To-Be is expected to confer \$407,917 of greater value to client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$219,253 of greater value to client's contacts.	Because the expected value difference is \$0 To-Be is expected to provide no net benefit or loss to the client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$164,298 of greater value to client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$822,528 of greater value to client's contacts.	Because the expected value difference is positive, To-Be is expected to confer \$485,169 of greater value to client's contacts.
		Cost-Benefit (Expected 'Indirect Social' Value Difference - Expected Investment Difference)		(\$ 444,623)	\$ 216,173	(\$ 715,704)	\$ 201,218	\$ 116,368	(\$ 1,876,431)
		Base Case Interpretation		The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide a net loss of \$444,623 to client's contacts.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$216,173 to client's contacts.	The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide a net loss of \$715,704 to client's contacts.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$201,218 to client's contacts.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$116,368 to client's contacts.	The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide a net loss of \$1,876,431 to client's contacts.

**Table 5.14- The ‘total social’ value and net benefit from the modified ICMC**

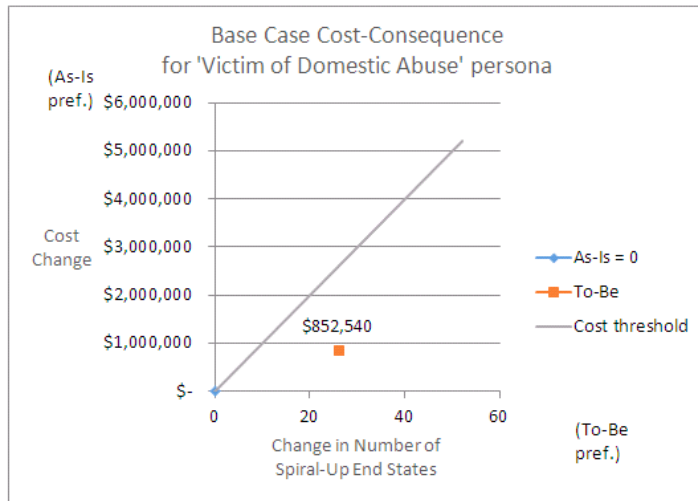
		Persona		Victim of Domestic Violence	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
Value	Total Social Value	Expected 'Total Social' Value Difference	(ToBe - AsIs)	\$ 3,970,294	\$ 1,069,253	\$ 2,345,479	\$ 239,625	\$ 1,192,694	\$ 13,824,522
		Base Case Interpretation		Because the expected value difference is positive, To-Be is expected to confer \$3,970,294 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$1,069,253 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$2,345,479 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$239,625 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$1,192,694 of greater value to society altogether.	Because the expected value difference is positive, To-Be is expected to confer \$13,824,522 of greater value to society altogether.
		Cost-Benefit (Expected 'Total Social' Value Difference - Expected Investment Difference)		\$ 3,117,754	\$ 1,066,173	\$ 1,629,775	\$ 276,545	\$ 486,534	\$ 11,462,922
		Base Case Interpretation		The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$3,117,754 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$1,066,173 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$1,629,775 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$276,545 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$486,534 to society altogether.	The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide a greater net benefit of \$11,462,922 to society altogether.



Table 5.14 is the sum of the relevant values from Table 5.11, Table 5.12, and Table 5.13, which add up to the net SROI. The ICMC calculates the net benefit by deducting the total investment cost from this sum. In Table 5.14 the expected value difference from the total social perspective is \$3,970,294, which is the sum of the expected value difference from the client perspective of \$2,924,673 (Table 5.11), social direct of \$637,704 (Table 5.12), and from the social indirect perspective of \$407,917 (Table 5.13). When the ICMC deducts the investment cost of \$852,540 (Table 5.10) off the expected value difference from the total social perspective of \$3,970,294, it will result in a net benefit-cost of \$3,117,754 for interoperable services for the victim of domestic violence (Table 5.14).

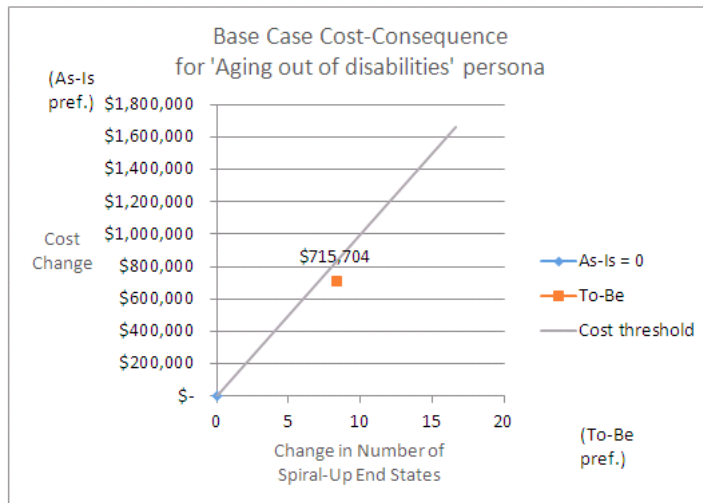
## Graphs

Figure 5.5, and Figure 5.6 are the graphical display of the cost-consequences listed in Table 5.10. For the domestic violence client, the position of the To Be square dot, which is below and to the right of the WTP line, is indicative that the cost-consequence of \$32,765 per improved client is well below the \$100,000 per client WTP limit.



Because the expected investment difference is positive, To-Be is expected to cost \$852,540 more than As-Is. The number of improved clients ('Spiral Up') is 26 more in To-Be than As-Is. To-Be is expected to save \$32,765 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to client. The expected difference in value is greater than the expected cost of investment, so To-Be is expected to provide greater net benefit to client.

**Figure 5.5- Cost-consequence graph of 'Domestic violence' (modified ICMC)**



Because the expected investment difference is positive, To-Be is expected to cost \$715,704 more than As-Is. The number of improved clients ('Spiral Up') is 8 more in To-Be than As-Is. To-Be is expected to save \$86,150 for every client helped to 'spiral up,' over what As-Is would have accomplished. Because the expected value difference is positive, To-Be is expected to confer greater value to client. The expected difference in value is less than the expected cost of investment, so To-Be is expected to provide less net benefit to client.

**Figure 5.6- Cost-consequence graph of 'Aging out of disabilities'**

## Sensitivity analysis

The Tornado diagram for the investment costs for the victim of domestic violence persona in Figure 5.7 reveals that the As Is Spiral Down costs can lead the cost of the total investment to above \$4 million. This diagram also reveals that the variability in the investment costs is mostly due to the As Is Spiral Down costs, but the To Be Spiral Up and Down costs can also lead the amount of the investment cost to change from a positive amount to a negative amount and vice versa.

The expected value difference from the total social perspective of \$3,970,294 and the Total benefit-cost of \$3,117,754 are both, however, subject to large variations as shown in Figure 5.10. The left panel of this figure shows that the total social value can vary from as low as a net loss of over \$20 million to a net gain of over \$30 million. The parameters that may change this value from positive to negative are the To Be Spiral Up and Down value as well as the To Be Spiral Up probability. In a similar way, the cost-benefit can vary from as low as less than -\$20 million to over \$30 million. The parameters that may change this value from positive to negative are the As Is and To Be Spiral Down values, the To Be Spiral Up probability and value, and As Is Spiral Down costs. Figure 5.11 and Figure 5.12 display the Sensitivity analysis of Total Social Value and Net Benefit for the Aging out of Disabilities and the Homeless Family for a comparison discussion, which takes place under Verification.

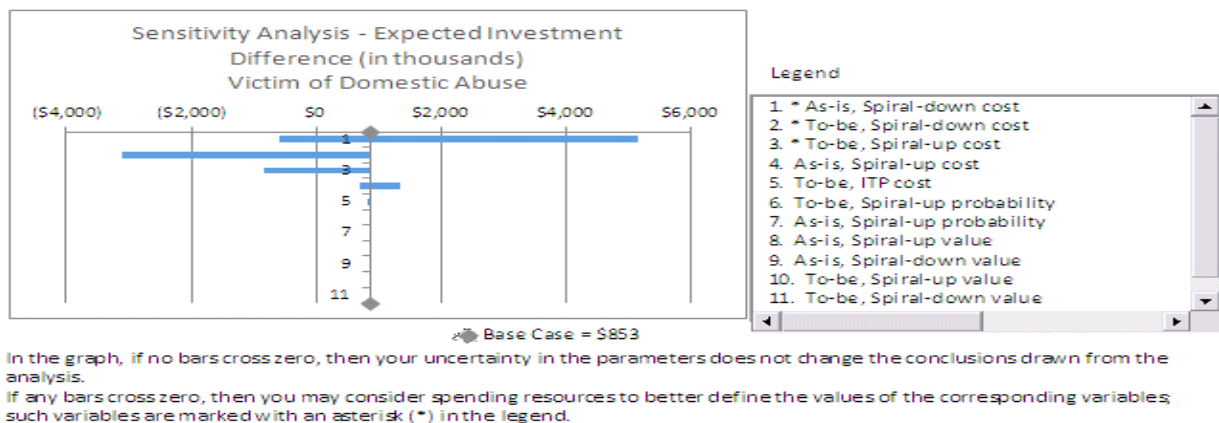


Figure 5.7- Sensitivity analysis of Investment costs for Domestic Violence (modified ICMC)

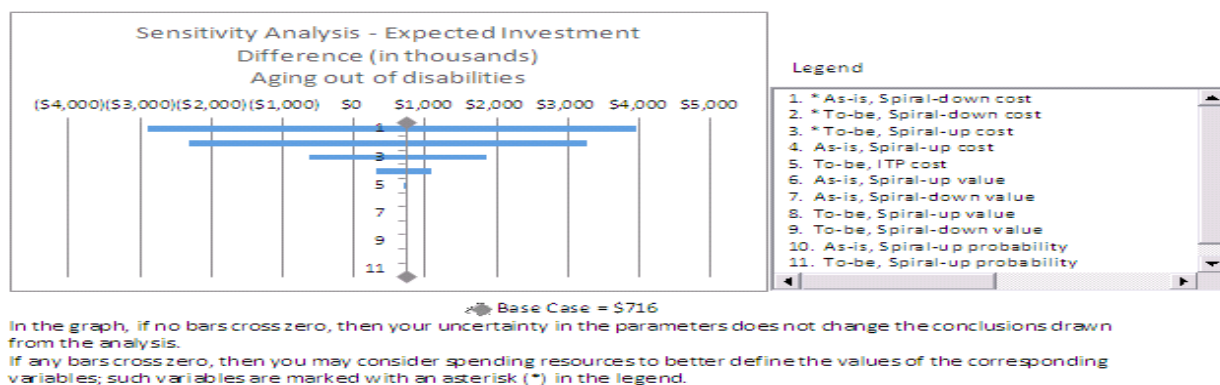


Figure 5.8- Sensitivity analysis of Investment costs for the Aging out of Disabilities

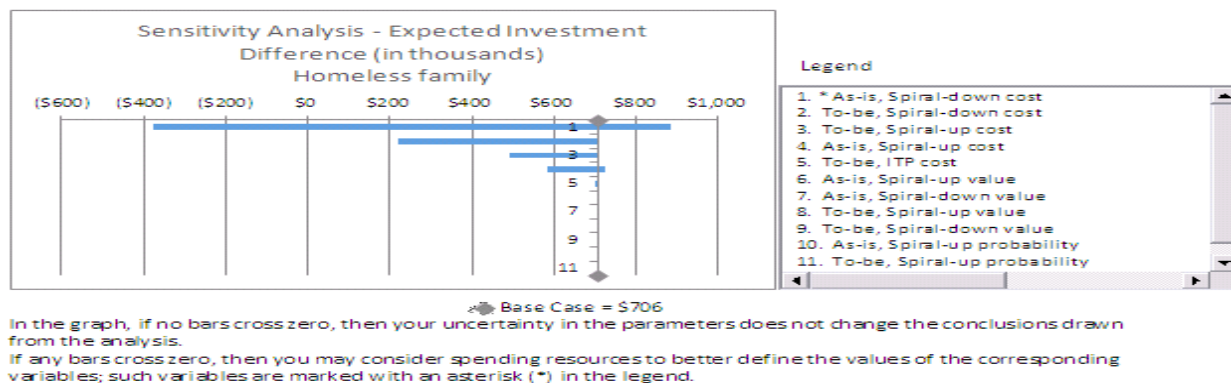
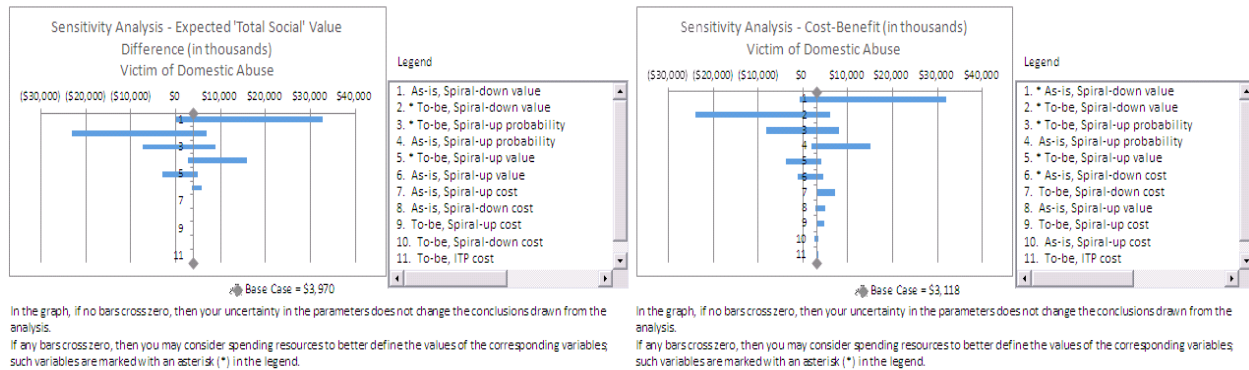
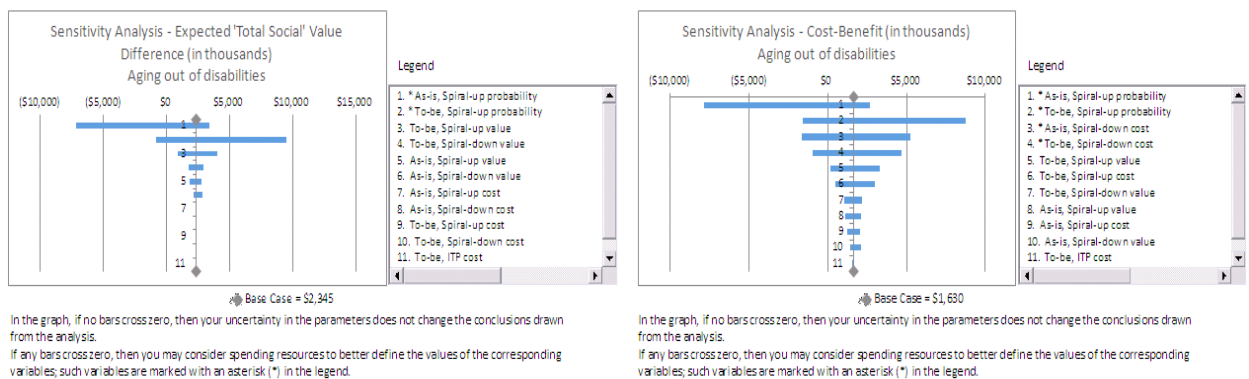


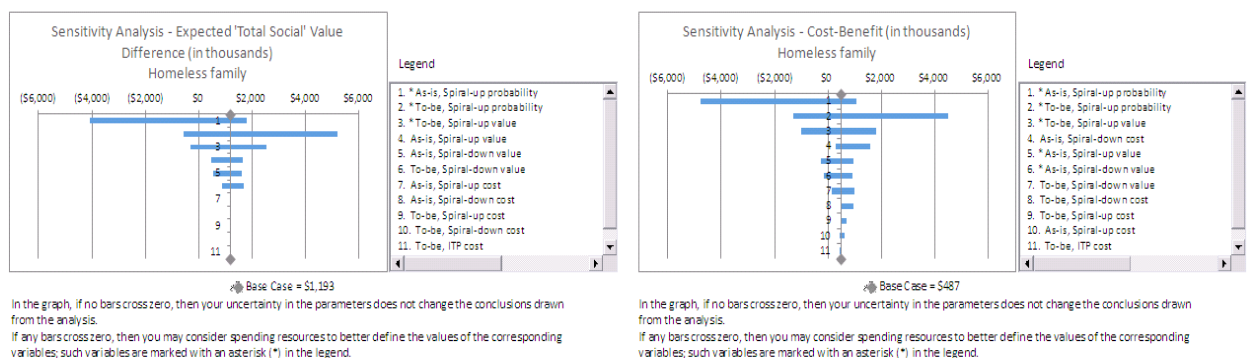
Figure 5.9- Sensitivity analysis of Investment costs for the Homeless Family



**Figure 5.10- Sensitivity analysis of Total Social Value and Net Benefit for Domestic Violence (modified ICMC)**



**Figure 5.11- Sensitivity analysis of Total Social Value and Net Benefit for Aging out of Disabilities**



**Figure 5.12- Sensitivity analysis of Total Social Value and Net Benefit for Homeless Family**

The results of the external validation calculations show that the modified ICMC has the capacity to accommodate the victim of domestic violence persona and to produce reasonable results, which are similar in their format to the original ICMC. The base-case analysis shows that for the victim of domestic violence persona the costs of an investment in interoperability is greater than the costs of not investing in interoperability. The results also revealed that the expected benefits of implementing interoperability exceed the expected costs. Furthermore, the cost of implementing interoperability is below the Willingness to Pay (WTP) threshold of \$100,000 per client improved. All of this evidence suggests that an investment in interoperability is a prudent move in this case. However, the sensitivity analysis revealed broad ranges for the estimation of costs by magnitudes of 10 or 100 times of the baseline value, many of which exceeded the WTP. The sensitivity analyses also showed that, in each scenario, uncertainty in only one or two parameters would change the model's conclusion regarding the value of interoperability. Careful, prudent, and continuous evaluation of those parameters is highly recommended.

## **A comparison of the results of the original and modified ICMC**

The addition of the domestic violence persona and the development of the modified ICMC allows for the side-by-side comparison of the two models which in turn could fulfil another method for verification that is “verification of separate parts of a model one by one”(Eddy, et al., 2012). Chapter 4 displayed the results of the original ICMC and the previous section on external validation ended with the results of the modified ICMC. This section provides a comparison of the two sets of results.

The results from the modified ICMC model, discussed above, are comparable to the original ICMC model developed in Chapter 4. Table 5.10, which displays the costs and cost-consequences from the modified ICMC, has a similar structure to Table 4.6 presenting the costs and cost-consequences from the original ICMC. Therefore the expectation is that for the personas that were identical in the two calculators, the results should also be the same. Table 5.15 compares these results with one another.

As Table 5.15 displays, the main difference between the original ICMC and the modified ICMC results stems from adding the 120 cases of domestic violence victims. These victims replaced the Aging out of foster care persona. To compensate for these, 30 clients of aging out of foster care were added to the Aging out of disabilities. These changes, as expected, do not affect the other personas. The zeros under the three personas of pregnant teen, and the homeless family and adult in Table 5.15 verify this. The figures under the ‘Aging out of foster care -> Domestic Violence’ column are meaningless since they compare two different personas with two different cost structures.

**Table 5.15- Check table of differences between the original and the modified ICMC**

	Persona	Aging out of Foster Care -> Domestic Violence	Pregnant Teen	Aging out of Disabilities	Homeless Youth	Homeless Family	Homeless Adult
<b>Number</b>	Difference in Total Client Population	120	0	30	0	0	0
	Difference in difference in number of Spiral-up Cases	24	0	6	0	0	0
<b>Cost</b>	Difference in Expected Investment Difference	\$869,460	\$0	\$536,778	\$0	\$0	\$0
<b>Cost-Consequence</b>	Difference in Cost Consequence	\$40,911	\$0	\$0	\$0	\$0	\$0
<b>Value</b>	<b>Client</b>	Difference in Expected 'Client' Value Difference	\$2,853,503	\$0	\$213,508	\$0	\$0
		Difference in Cost-Benefit	\$1,984,043	\$0	-\$323,270	\$0	\$0
<b>Value</b>	<b>Direct Social Value</b>	Difference in Expected 'Direct Social' Value Difference	\$124,122	\$0	\$1,545,601	\$0	\$0
		Difference in Cost-Benefit	-\$745,338	\$0	\$1,008,823	\$0	\$0
<b>Value</b>	<b>Indirect Social Value</b>	Difference in Expected 'Indirect Social' Value Difference	\$407,917	\$0	\$0	\$0	\$0
		Difference in Cost-Benefit	-\$461,543	\$0	-\$536,778	\$0	\$0
<b>Value</b>	<b>Total Social Value</b>	Difference in Expected 'Total Social' Value Difference	\$3,385,543	\$0	\$1,759,109	\$0	\$0
		Difference in Cost-Benefit	\$2,516,083	\$0	\$1,222,331	\$0	\$0

The zero difference shown under the cost-consequence and the Difference in Expected Indirect Social Value for the Aging out of Disabilities is also expected. For the Difference in Expected Indirect Social Value, within the cost structure, the Expected Indirect Social Value of the Aging out of Disabilities persona is zero under both As Is and To Be. As a result, the difference of two zeros is also zero and independent of the number of clients. For the cost-consequence, despite the increased number of clients of the Aging out of disabilities persona in the modified ICMC, since



the total investment costs are also raised proportionally, the cost-consequence ratio remained constant at \$86,150 per additional client improved (Table 5.10).

The graphical display of the cost consequences also allows for their comparison. The comparison of Figure 4.4 which is the cost-consequence graph of 'Aging out of disabilities' from the original ICMC, and Figure 5.6, which is the same graph from the modified ICMC, highlights the proportional growth point. Since the rise in the investment costs was proportional to the number of clients, the relative geometrical position of the To Be dot on the cost consequence graph with more personas (Figure 5.6) remains the same as the one with less personas (Figure 4.4) even though this stretched the axes of the graph.

A comparison of Figure 5.8 from the modified model with Figure 4.9 from the original model, which are both Sensitivity analysis of Investment costs for the Aging out of Disabilities, reveals that it is not only the point estimate of the investment costs which is proportional with size of client population. This comparison reveals that the variance of the investment costs is also proportional to the number of the clients. Since the size of the Homeless family persona did not change, the tornado diagrams of investment costs for this persona are identical in both the original model as displayed in Figure 4.10, and the modified model shown in Figure 5.9.

The proportionality of the variance of the size of the population also carries over to the benefit side of the ICMC results. Figure 4.12 and Figure 5.11 are sensitivity analysis of Total Social Value and Net Benefit for Aging out of Disabilities for the original and modified ICMC respectively. The comparison of Figure 4.12, with Figure 5.11 reveals that since the Aging out of Disabilities persona increased by 30 people, the scale of the distribution has proportionally changed, even though the shape of the distribution and the sensitive parameters remain the same. The sensitivity parameters for the expected total social value remain the Spiral Up probability under As Is and To

Be. The sensitivity parameters for the cost-benefit are consistently the Spiral Up probability and Spiral Down cost both under As Is and To Be.

Figure 4.13 and Figure 5.12 are the Sensitivity analyses of Total Social Value and Net Benefit for Homeless Family and show the Tornado diagrams of the benefits that the Homeless family accrues from the original and modified ICMC respectively. Since there was no change in the number of clients of the homeless family, the shape and the scale of the distributions in Figure 4.13 and Figure 5.12 from the two versions of the ICMC are identical.

## Conclusion

The results from the retrofitting showed that the ICMC can accommodate external personas and deliver reasonable results. The comparison of results showed that the results from the original and modified ICMC reasonably match. These results confirm that interoperability despite its high startup and implementation costs, has the potential to deliver savings to clients of department health and human services, the departments of health and human services, and to society at large.

One can argue that given the large variations in costs that the ICMC produces makes it difficult for managers of departments of health human services to come to a solid yes or no answer on whether the investment in interoperability would be the best use of their hard to obtain health dollars. However, it is reasonable to consider that the same sensitivity analysis is able to determine which of the four condition key conditions (Spiral Up and Down under As Is and To Be) will be most critical components in determining the profitability of the investment. This additional foresight and knowledge on the effects of interoperability (or the lack of it) on clients, and government may alone may be enough to merit the replication of this study, and the use of the ICMC in other jurisdictions.

Despite the importance which Eddy et al (2012) highlight for sensitivity analysis they emphasize that it cannot replace the validation process:

***No matter how many validations are done, there will inevitably be uncertainty about some aspects of a model. Sensitivity analysis can be used to explore how a model's results change on variation in inputs [6], but by itself, it does not evaluate how accurately a model simulates what occurs in reality. Sensitivity analysis is an important complement to validation, but not a substitute for it (Eddy, et al., 2012).***

The results of this chapter also offer some insights as to where some of threats to the validity of the ICMC may be found. Chapter 6 discusses some of these insights, and offers a critique of the ICMC. Eddy and colleagues (2012) also offer two other measures of validity: cross validation and predictive

validation, and argue that these two are the ultimate tests of the validity of any predictive model, namely the ICMC. However, the cross validation and predictive validation of the ICMC will need to wait until either better models are developed or interoperability is implemented and its observed costs can be compared to the expected costs calculated by the ICMC.

## Chapter 6 - **Discussion**

### **Introduction**

In introducing the original and modified ICMC in Chapters 3 and Chapter 5, several assumptions were also introduced which merit further discussion. Furthermore, while the Creswell et al (2006) model offered the theoretical basis for the ICMC and Eddy et al (2012) provided a framework for verifying and retrofitting the ICMC, the works of neither of these authors delivers a framework for the critique of a predictive cost model.

This chapter offers critiques that apply to both the original and the modified ICMCs. The critique is in the format of a series of questions that the literature routinely uses for the critique of cost studies. The chapter then proceeds with a discussion on some of the shortcomings of this study. This final chapter concludes with a review of points that may have the potential to improve in future cost related studies of human services delivery.

## **A critical discussion of the ICMC**

This discussion employs a standard checklist of questions to assess the quality of cost studies. The questions in this segment are based on a commonly used textbook (Rascati, 2009). The Rascati (2009) methodology for critique utilizes 14 questions, which are used here to discuss the construction of both the original and the modified ICMC. These questions are used to critique original white paper report of the ICMC (Lehmann, 2014a).

### **Question 1- Title**

The title of the whitepaper is appropriate. As noted in the introduction, Lehmann (2014) compares the current system of human services delivery in MC DHHS (As-Is), in which health services and human services are united under a single office, “however, the services are siloed”, with a presumed future state of “To-Be”, which is a combination of intensive services (“Intensive Teaming Protocol” (ITP)) coupled with an integrated information system (“Enterprise Integrated Care Management” (eICM)). “Intensive services” refer to cases which require two or more of Montgomery County Department of Health and Human Services (MC DHHS) services in a coordinated fashion. “Integrated information system” refers to an architecture that focuses on client data and not on the system that generated those data.” Lehmann notes that the framework used for this SROI is proposed by the SROI Network’s 2012 Guide (Nicholls, et al., 2012). Therefore, given that the title “Social Return on Investment Model – Interoperability Business Case Analysis” describes this study as a study of an interoperability intervention, and given that it clearly notes the Social Return on Investment (SROI) methodology, which is referenced by an appropriate source for this methodology, it is an appropriate title for this paper. The title

lacks the clarity that the business environment and context is one of health and human services. The title might become more clear if it somehow includes the alternatives (As-Is and To-Be) that are being compared.

## Question 2- Objectives

The questions that Lehmann notes for this analysis are:

1. ***“What impact does an investment in an interoperability system and intensive teaming protocol make on the lives of MC DHHS department’s most difficult cases?”***
2. ***“In what way might Integration and Interoperability have value to society, where “society” is taken to mean the client, his or her family, and others affected by the client’s life course?”***
3. ***“Will the investment in an individual client have positive impact on him (or her), on the government agencies, and on those around the client? Will this impact be large enough to warrant the investment?”(Lehmann, 2014a)***

Given that the questions are clearly stated at the beginning of the paper, the objective of the analysis is clear and appropriate. However, none of the questions includes a focus, and hence leaves a lot up to the readers’ assumptions. For example, in the first question, and last question the word “impact” is vague. How is “impact” measured? Is it lowering costs? Or is it increasing an effect (or consequence)? If so what effect and how is that effect measured? If this “impact” is a combinatory measure of both cost and effect, that measure should be clearly described within the question. The same problems exist with the use of the word “value” in the second question. It should be noted that Lehmann (2014) does touch upon this question by noting:

***“By considering the toughest cases that the MC DHHS agency is in a position to assist, this report will demonstrate through rigorous analysis the degree to which improving social services, through capital investments in systems and performance improvements, (1) can save in expenses for each client, (2) can improve client outcomes in a quantifiable way, and (3) can affect outcomes of those affected by the clients.” (Lehmann, 2014a)***

However, these definitions are not solidly embedded within the questions and objectives stated, and the statement above seems to imply a positive outcomes bias by mentioning the words “demonstrate”, “save” and “improve”, rather than posing a question.

In describing the task of the model under the methods section, Lehmann (2014) poses a more solid question:

***“The task of the model was to answer the question: What impact does eICM make on the lives of MC DHHS department’s most difficult cases? In particular, what impact does the To-Be service bundle, as experienced in a year, have on the subsequent 4 years of a client’s life, compared to the current, As-Is service bundle?” (Lehmann, 2014a)***

While this question is better quantified in that it establishes the time perspective of the study, and describes the alternative As-Is vs To-Be, again, the vagueness of the term “impact” remains.

### **Question 3- Alternative**

The next question is whether the appropriate alternatives or comparators are considered. Lehmann considers two alternatives As-Is and To-Be as:

***“This Social Return on Investment (SROI) model seeks to compare two strategies of providing human-services care: “As-Is” and “To-Be.” (Lehmann, 2014a)***

This is an appropriate way of considering the alternatives. However, in this type of prospective cohort analysis, it must be considered that in an organization as large as MC DHHS where many other factors that may affect client outcomes (besides interoperability) are continuously changing over time, hence isolating the effect of interoperability alone, may prove to be difficult to model. For example, currently MC DHHS is under taking a



organization wide Quality of Services Review (QSR) program, which is aimed to review and improve the services delivered in all service areas of the organization. This program does not include interoperability within its agenda. Therefore, when both programs are completed, it may prove difficult to separate and hone into the effects of each program separately.

#### **Question 4- Description of Alternatives**

The fourth question is whether a comprehensive description of the competing alternatives is given. In this section, Lehmann (2014) does describe the two alternatives As-Is and To-Be as:

*“For Montgomery County, “As-Is,” itself, is an example of a “pooled budgets” approach, uniting health services with human services under a single office. However, the services are siloed as in most human-services bureaus. “To-Be” is a combination of intensive services (“Intensive Teaming Protocol” (ITP)) coupled with an integrated information system (“Enterprise Integrated Care Management” (eICM)). “Intensive services” refer to cases which require two or more of Montgomery County Department of Health and Human Services (MC DHHS) services in a coordinated fashion. “Integrated information system” refers to an architecture that focuses on client data and not on the system that generated those data.” (Lehmann, 2014a)*

These alternatives are appropriately described given the context of the project.

#### **Question 5- Perspective**

The following question focuses on addressing the perspective of the study. At this point it is important to understand a fundamental aspect of a SROI analysis, which is stakeholder analysis. In the introduction, Lehmann (2014) notes:

*“Value” depends on the perspective. Three perspectives are considered in this analysis: The client, the government agencies (taken as a whole) supporting the client, and society in general (primarily people who come in contact with the client).”(Lehmann, 2014a)*

For the client segment of the stakeholder analysis it should be noted that according to the needs of MC DHHS, Lehmann (2014) limits the analysis to six personas, which represent about 2% of MC DHHS total clients and are the most difficult and costly clients that are assumed to benefit the most from interoperability of services. As highlighted in table 2, of the Lehmann report, this 2% is represented by six specific client personas.

Each of these personas became the basis of the discussion of Lehmann (2014) with external expertise as well as MC DHHS leadership, program directors, and service area managers. However, at no stage was a representative of the client population interviewed. It therefore seems unclear that Lehmann's method has fully captured value from the client perspective. Since as a potential stakeholder, clients were not interviewed for this study, the "value" that the clients actually may gain or lose is assumed equal to the value that MC DHHS claims that they gain or lose. This assumption may lead to an observation bias. This form of observation bias may lead to the over estimation or under estimation of the costs of interoperability.

Lehmann (2014) also note that:

***"The typical SROI analysis for IT projects looks at the entirety of impact on as broad a range of stakeholders as possible and on as many outcomes as possible of a program intervention. Its goal is to justify the investment in terms of that totality. (Cresswell, 2004) The goals of this current analysis are narrower by focusing the investigation on the impact on a particular set of clients. Thus, broad impact, such as change to neighborhoods due to fewer homeless people on the street, or the wholesale effect on crime rates, cannot be addressed by this analysis."(Lehmann, 2014a)***

While this assumption is clearly stated out, its effect on the under-estimation of indirect social value also must be considered. A very recent study by Chetty and colleagues (2014) for the National Bureau of Economic Research reveals an associative relationship between possibilities for economic mobility and regional economic growth which has held

constant for all birth cohorts since 1970 (Chetty, Hendren, Kline, & Saez., 2014). This study shows that within the United States geographical areas that the possibility of economic mobility between generations is higher in areas that have become wealthier during the time of the study. Hence, any improvement of the client could in fact lead to greater economic opportunities for the County as a whole. However, quantifying these estimates in a way that the Lehmann model could utilize would need more research from the economics schools of thought.

### **Question 6- Study Type**

The sixth question posed by Rascati (2009) is based on the type of study, and from the various methods available for the study of costs, which method is specifically employed.

Lehmann (2014) notes:

***“The goal of the SROI analysis was to provide an evidence-based tool, or an Intensive Case Management Calculator (ICMC), to Montgomery County’s service program management to aid in the decision for investment in Integration and Interoperability while considering the possible desired outcomes for a client due to intervention of services.” (Lehmann, 2014a)***

Hence, Lehmann (2014) clearly notes the type of study as a Social Return on Investment (SROI) study.

Furthermore, the Guide to SROI notes that:

***“There are two types of SROI:  
Evaluative, which is conducted retrospectively and based on actual outcomes that have already taken place.  
Forecast, which predicts how much social value will be created if the activities meet their intended outcomes.  
Forecast SROIs are especially useful in the planning stages of an activity.  
They can help show how investment can maximise impact and are also useful for identifying what should be measured once the project is up and running.”  
(Nicholls, et al., 2012)***

According to this definition, the Lehmann (2014) study clearly fits the definition of a Forecast SROI study. Furthermore, the ICMC is designed to deliver an understanding of the types of costs and benefits that interoperability may deliver to a DHHS and its clients, prior to implementation of interoperability. The ICMCs sensitivity analysis function also delivers the areas, in which a DHHS and its clients may have the greatest variability in cost and benefits. Therefore, by delivering this knowledge, the use of the ICMC and the Forecast SROI method enables a DHHS to focus their attention on areas which may produce the greatest risks.

### Question 7- Relevant Costs

The major costs that Lehmann (2014) considers are five:

1. Investment cost that happens only under To Be.

Furthermore, looking forward in time Lehman proposes two states for a client:

***“One result of this list was to ask the stakeholders to articulate what the end states were for the personas of interest. In particular, using the language of the Service Area Representatives, we labeled the two primary end states for each persona, “spiral up” and “spiral down” which expressed the client’s life course after receiving the set of available services.”(Lehmann, 2014a)***

So the other costs that Lehmann (2014) considers are:

- c) Expected Cost of Spiraling Up.
- d) Expected Cost of Spiraling Down.

Given that Spiraling Up and/or Spiraling Down can occur under both As Is and To Be, the combinations are:

- 2- Expected Cost of Spiraling Up under As Is
- 3- Expected Cost of Spiraling Up under To Be
- 4- Expected Cost of Spiraling Down under As Is

## 5- Expected Cost of Spiraling Down under To Be

Within each of these combinations, the Lehmann model thoroughly considers the cost of receiving and not receiving services delivered by the MC DHHS. However, as Chapters 3 and 5 point out, there are costs that the ICMC fails to quantify.

As an example of such hidden costs, the section on establishing impact in Chapter 3 notes that within the MC DHHS committee responsible for establishing interoperability (eSARS), there are differences in opinions on whether diagnostic information, specifically in the case of mental health and substance abuse, should be shared. In the past, this form of information sharing has led to discrimination of patients with such diagnoses. There is a cost to this form of discrimination, that due to its ethical and legal nature, the ICMC is unable to quantify this cost.

Furthermore, the Chapter 5 methods for Mapping persona conditions to services and outcomes, points out that since the ICMC is limited to the services delivered within the DHHS, it does not cover the costs of the additional burden of immigrant clients due to immigration. In the same line, the ICMC does not cover costs other costs related to judicial and law enforcement systems, or those related to the schooling system. By not covering these costs, the ICMC makes itself vulnerable to underestimating the costs of interoperability.

## Question 8- Relevant Outcomes

Rastcati (2009) next questions focuses on the relevant outcomes and if the important or relevant outcomes are measured. In the methods of establishing impact Lehmann (2014) notes:

***“Outcomes (and their associated costs) were attributed to the 3 perspectives as follows:***

- 1. Client: Value directly experienced. Generally, this was valuated as income.**
- 2. Direct Social: Value from not having to provide services otherwise necessary. Valuated as cost avoidance.**
- 3. Indirect Social: Value experienced by others (generally negative). Valuated in terms of social costs (often, costs avoided). (Lehmann, 2014a)**

Also, as previously mentioned in perspective, this study focuses on a small percentage of the most costly clients that are most likely to benefit from interoperability, and are represented by 6 personas. Furthermore, as seen previously there were four combinations of conditions that each persona could fall into:

- 1- Spiraling Up under As Is
- 2- Spiraling Up under To Be
- 3- Spiraling Down under As Is
- 4- Spiraling Down under To Be

Finally, in combining the costs with the outcomes, Lehmann (2014) explains:

***“In order to address if there is a net savings from instituting To-Be, the model produces a cost-benefit conclusion, expressed as the difference in expected costs of As-Is and To-Be and the expected value of As-Is and To-Be. If the difference is positive, then To-Be is cost saving. If the difference is negative, then To-Be is costly.”(Lehmann, 2014a)***

In addition to the cost-benefit analysis, Lehmann (2014) also presents a cost-consequence analysis as he explains:

***“in order to address value holistically, a cost-consequence analysis is performed. (Fenwick, Macdonald, & Thomson, 2013) The results are expressed as dollars expected to be invested for each client improved, over As-Is.(Lehmann, 2014a)”***

Both the cost-benefit and cost-consequence analysis are routinely used in the literature and are reasonable methods of expressing final outcomes.

### Question 9- Discounting

The ninth question addresses the issue of discounting and whether the adjustments or discounting made are appropriate. Lehmann (2014) mentions that the scope of the study is five years and that

***“No accounting was made for inflation for dollar values less than 5 years old; otherwise, standard inflation adjustment was made ([http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm)). No accounting was made of discounting.”(Lehmann, 2014a)***

This is reasonable, although it would have been more precise if the ICMC would account for discounting by discounting the costs and the values that occur in the future to their Net Present Value. Under its current configuration, the results of the ICMC may underestimate the total costs.

### Question 10- Assumptions

The next question is on the assumptions of the model and if the assumptions are reasonable. In defining the outcomes, Lehmann (2014) argues that:

***“Considering the severity of condition of the clients in the cohort considered in this analysis, it is fair to claim that “spiraling up,” a social state of being housed, gainfully employed, with good permanent connections, is in fact saving a “social life,” if not a physical one. Just as medicine used certain threshold for “life saved” or “quality-adjusted life saved,” we can talk about “social life saved.” Thus, cost-consequence is about how much a jurisdiction is willing to invest to save a social life.”(Lehmann, 2014a)***

The general analogy of comparing a “social life” to “physical life” is valid and is the basis of the idea that links health and human services to form integrated care. This line of research has been heavily influenced and driven by the works of Michael Marmot (Marmot, 1982) and has gained more attention in the medical literature in recent years under the heading of social determinants of health (WHO, 2014). However, to assume it is as

developed as medicine in classifying and validating outcomes would be an extra expectation of a field that is young in age.

In medicine, years of work in various fields, namely the International Classification of Disease (ICD), Adjusted Clinical Groups (ACG), Diagnosis Related Groups (DRG), and more recently Burden of Disease studies have empowered the field of medicine with a solid background that enables the development of complex cost-effectiveness studies we observe today. Such background studies and standardized classifications are either non-existent or are still weak in the field of social work.

Interestingly, the most solid outcomes that Lehmann (2014) uses, such as the cost of prenatal care for a pregnant teen, or the cost of HIV infection, are borrowed from various medical fields. In fact, in the case of the Permanent Connections outcome, which is arguably the most socially related outcome of all, Lehmann (2014) notes:

***“We reviewed the literature on social capital, (Noll, 2002) connectedness, (Grossman & Bulle, 2006) belonging. (Brooks, Magnusson, Spencer, & Morgan, 2012) In case, connectedness was identified as a risk (causative factor) for outcomes, and we did not find a measure that we could use.” (Lehmann, 2014a)***

This lack of literature is perhaps a testament, that both the personas and the outcomes should become further standardized to allow for a better understanding and hence better models of the social determinants of health.

The second assumption or lack thereof, is the issue of mental health. Of the 6 personas 5 of them explicitly have mental health issues, and the only one that does not (pregnant teen) is reported to be failing in school, which is highly correlated with mental health issues in teenagers (Respress, Morris, Gary, Lewin, & Francis, 2013). Yet the outcome of mental health is not included in the MC DHHS list of traceable outcomes. Not accounting for mental health in the model could result in an omitted variable bias, and hence



produce greater variability that is unaccounted for. Furthermore, the issue of mental health magnifies the need for standardization of the personas. Psychiatry is an entire field of and the Diagnostic Statistical Manual presents detailed diagnostic criteria for a wide array of mental health disorders. Like other fields of medicine, a broad array of Burden of Disease studies and Cost-Effectiveness studies are available for a wide variety of treatment options available for each condition. The discrepancy between the level of detail that such studies go in to, and the generalization of noting “mental health” instead of a specific condition in the personas, reveals that the Lehmann (2014) report may be having difficulty in defining and honing the precise level of analysis when it comes to mental health issues.

Finally as earlier discussed under question 5, there is an assumption that there is an indirect benefit (apart from deadweight costs) in a society or community where there is more economic opportunity for growth. It is assumed that in these societies people trust each other better and due to this trust more economic transactions take place and hence the whole society becomes wealthier. However, few quantitative studies are available on this subject, and there is a hope that more will come out from the economics field.

### **Question 11- Sensitivity Analysis**

Question 11 asks about sensitivity analysis, and how it was conducted. Perhaps the strongest part of the Lehmann (2014) analysis and the resulting calculator is its powerful and robust sensitivity analysis tool. Lehmann (2014) describes it as:

*“In addition, we will present the results of the sensitivity analyses for the personas. Here, the primary variables (Spiral Up probability, cost, value for As-Is and To Be and Spiral Down probability, etc.) are varied across their possible values. The tables will display for which values, the threshold [where the net cost-benefit or consequence changes from negative to positive] is “near” or “far” from the base case. The Calculator produces graphs like this:[figure of a tornado diagram graph provided] The grey diamond denotes the base case. “0” is where a threshold would be. In the case in the figure, the*

*bar which represents all results for ranging To be, Spiral up cost through its range of possibilities crosses 0. Crossing 0 means that the conclusion, in this case the base case result that To Be confers less cost–benefit over As-Is, is sensitive to the base-case estimate for To be, Spiral up cost. In particular, the wider the bar, the greater the potential impact, numerically, on the quantity of interest (Cost Difference, Value Difference, etc.) In addition, the base case value is near the 0 threshold, suggesting true sensitivity...”(Lehmann, 2014a)*

Furthermore, using the calculator, Lehmann (2014) is able to create tables, for each persona, indicating which variables in what type of analysis have stronger or weaker effects on the net result of the entire model. Lehmann (2014) explains the coding of these tables as follows:

*Thus, the tables for sensitivity analysis will list n for variables whose base-case value is near threshold, f for those that are far from threshold, and blank for variables not crossing 0 at all. It will list b for those parameters for which the conclusion is barely sensitive. Alternatively we label the parameters by their relative size of impact (w for wide, m for medium, s for small) (Lehmann, 2014a).*

Table 6.1 offers an example of such a table for the aging out of foster care persona from the original ICMC. In explaining Table 6.1 Lehmann notes:

*“Thus, the tables for sensitivity analysis will list n for variables whose base-case value is near threshold, f for those that are far from threshold, and blank for variables not crossing 0 at all. It will list b for those parameters for which the conclusion is barely sensitive (Lehmann, 2014a).*

The best utility of Table 6.1 is its power to aid the actual decision making process, which is the ultimate aim of any cost study. Presented with the variety of factors that can ultimately affect the outcome decision makers and executives are trying to reach, the executives often fall into meager subjective advice seeking. The results presented in this table are also subjective, in the sense that they are dependent on the inputs of the model. However, the results themselves are honed to aid a speedy decision that are dependent on the parameters the administrators choose to input in the ICMC. For example in the table

presented above, a quick look shows the greatest variance that will affect the total cost-benefit, the direct value difference, and the client cost-benefit in the case of aging out of foster care, is the To Be Spiral Up value. Having this knowledge before starting an interoperability project, practically informs the decision maker that this is an end loaded project, where in order to be cost-beneficial, most of the energy of the organization must be spent after (rather than before) the implementation of interoperability and on value maximization through helping the client spiral up. This information allows the executive to allocate resources strategically across time, in order to maximize the output of organizational objectives.

**Table 6.1- Comparison of variable effect on total sensitivity analysis of the model (Lehmann, 2014a)**

	Cost Differences	Client Value Difference	Client Cost Benefit	Direct Value Difference	Direct Cost Benefit	Total Value Difference	Total Cost Benefit
As-Is, Spiral-up cost	n		n		n		n
As-Is, Spiral-down cost	n		n		n		n
As-Is, Spiral-up probability		n		n	n	n	n
As-Is, Spiral-up value		n	b				
As-Is, Spiral-down value		n					
To-Be, Spiral-up probability				n	n	n	n
To-Be, Spiral-up value		n	b	b		n	b
To-Be, Spiral-down value		n					

## Question 12- Limitations

Lehmann (2014) does acknowledge the limitations of the model and calculator:

*There are many limitations to our analysis. We did not interview clients to find out how they value their own states or outcomes. Any effort at understanding decision making must ask the stakeholders. For instance, patients and parents disagree quite markedly on the value of certain “disastrous” NICU outcomes.(Saigal, et al., 2000) We did not track prior clients like ours through data systems in the State of Maryland. We used averages from both Montgomery County and from the literature, yet this cohort is noted for not being average. (When possible, we did use research data that was as specific as possible.) Our view of eICM To Be state was monolithic: While the ROTI model accounted for differences in interoperability and intensive teaming, our model made no effort to separate out the individual effects. Similarly, we did not tease apart which services might be more or less effective. Our scope of “social value” was narrow. We did not model changes to the neighborhood, although the small size of the cohort suggests that they alone would not have affected it much. And with Number Differences less than 15, it is hard to imagine that reduction in the population of the homeless would have a large impact on the neighborhood (entirely different from the value there is in taking 15 more people off the street to the clients themselves.) Other impacts that are IT specific include information safety and security issues,(GAO, 2013) that requires a custom-interviewing process. There are of course limitations within each scenario, primarily from being simplistic.(Lehmann, 2014a)*

and argues:

*“However, simplicity is precisely a strength of heuristic tools: Get a rough estimate, see what the implication are, and get the data that the model say will help the most. If that process can be kept fast and cheap, it will have delivered its own social return.”(Lehmann, 2014a)*

The ICMC namely that it does not consider the secondary effects of data sharing, and their potential for harm and discrimination (as pointed out in Chapter 3) and other aspects of its “narrow” scope namely its omission of the interaction departments of health and human services with schooling system, and law enforcement.

On the hand, considering the principle of parsimony, which notes that a model should be as simple as possible, but no simpler, it can be argued that the strength of

Lehmann's (2014) calculator is not in its current simplicity, but rather in its flexibility and robustness as demonstrated in Chapter 5. This flexibility allows users to complete and customize the model easily according to their own personas and the needs of their DHHS.

### **Question 13- Generalizability**

The next question asks whether extrapolations beyond the population studied are proper and if the model is generalizable. As mentioned in the previous paragraph, one of the strengths of ICMC is in its flexibility and robustness. This flexibility allows the potential for users to complete and customize the model easily according to their own needs.

Although the current version of the ICMC is customized to fit the needs of MC DHHS, the open source design of the ICMC allows users from other health jurisdictions to adapt and refit the model with the data and cost structures that would be applicable to their department's setting, and personas.

The limitation of the ICMC's current capacity to accept six personas may become a hindrance to managers who deem that the clients who may benefit the most from interoperability may fall into more than six personas. This limitation however, does not stop managers from performing the analysis one by one for each persona. This was demonstrated in Chapter 5, where the need to analyze the additional persona of a victim of domestic violence, did not change the results of the other personas. Furthermore, if there is a need for the joint analysis of more than six personas, the administrators can modify and customize the open source code of the ICMC to fit their individual needs.

#### Question 14- Unbiased Conclusions

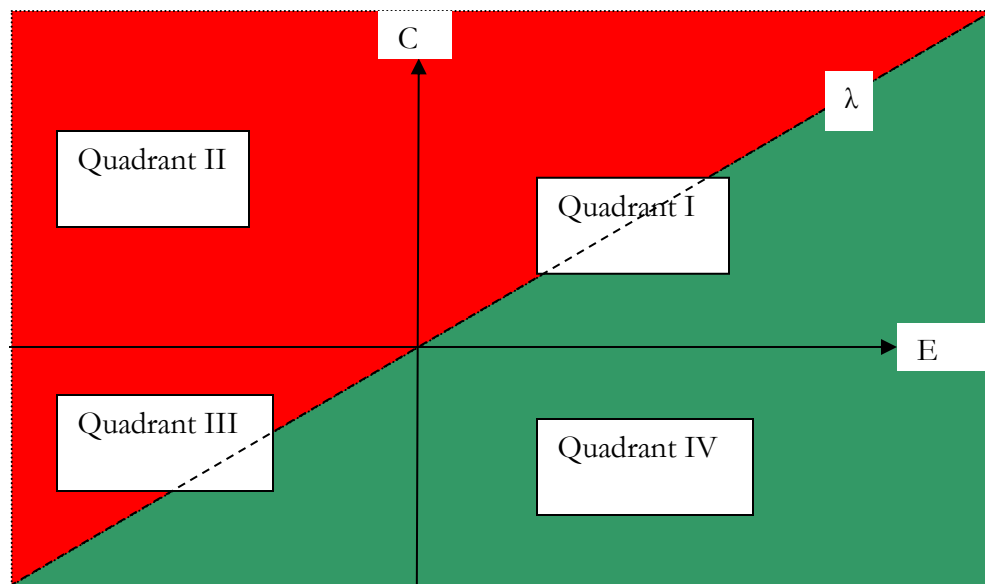
The 14<sup>th</sup> and last of the Rascati (2009) questions focuses on unbiased conclusions and asks about the presentation of a summary of unbiased results. The way the results are presented by the Lehmann (2014) calculator, in both graphical and text formats are generally unbiased and allow for their easy understanding by decision makers.

One area that the ICMC could improve would be in the reporting of negative Incremental Cost Effectiveness Ratios. The health economic concepts of cost, cost-benefit, cost-effectiveness, cost-utility, cost-consequence, all have a common numerator of cost. Cost is measured in a monetary unit, which is usually the US Dollar. The denominator for cost studies is one unit of the subject of analysis. The denominator for cost-benefit is benefit, which is also a monetary unit, measured usually in the US Dollar. The denominator for cost-effectiveness is the effect, measured in natural units or objective outcomes as in the SI units of mass, time, or length. The denominator for cost-utility is outcomes that are more subjective such as Quality Adjusted Life Years (QALY) or Disability Adjusted Life Years (DALY). The denominator for cost-consequence is clinical process indicators that are subjective, and dependent on the subject of analysis.

The values for cost and cost-benefit are easily calculated. For cost, the value for choosing between two interventions is  $C_2 - C_1$  and for cost benefit it is  $C_1 - B_1$ . For the cost-effectiveness family (cost-effectiveness, cost-utility, cost-consequence), calculating the value is straightforward through  $\frac{C_2 - C_1}{E_2 - E_1}$  where  $E_1$  and  $E_2$  are the mean effects for the before and after intervention. However since the numerator and the denominator are of two different units alternative approaches have been suggested when the Incremental Cost Effectiveness Ratio (ICER) is negative (Chaudhary & Stearns, 1996; Gardiner, et al., 1995;

Laska, Meisner, & Siegel, 1997; Polsky, Glick, Willke, & Schulman, 1997; Stinnett & Mullahy, 1998; Wakker & Klaassen, 1995; Willan & O'Brien, 1996).

In explaining this, Stinnett & Mullahy (1998) put forth . As displayed, the Y axis represents Cost, and Effect is portrayed on the X axis. The dashed  $\lambda$  line is the Willingness to Pay (WTP). If a CE point estimate falls anywhere in quadrant IV or below the  $\lambda$  line in quadrants I or III the intervention should be accepted (if it is not dominated by another intervention) and if not it should be rejected.



**Figure 6.1- The  $\Delta C$ - $\Delta E$  curve**

However, for some cases, as in the case of the cost-consequence for the Aging out of Foster Care Persona or the Homeless youth persona, both shown in Chapter 4 (Figure 4.2 and Figure 4.5 respectively), sometimes a point estimate falls in quadrant IV with a negative ICER. For these cases Stinnett & Mullahy (1998) note that:

*the new treatment is estimated to be both less costly and more effective than its comparator; thus, in this quadrant, a large magnitude is desirable in both the numerator and the denominator of the CE ratio. However, these two desirable features drive point estimate in opposite directions: large incremental health gains in the denominator drive the ratio closer to zero, but*

***large incremental cost savings in the numerator drive the ratio toward negative infinity (Stinnett & Mullahy, 1998).***

Given the problems with the joint interpretation of negative changes in costs or effects, the most straight forward solution present the results of cost and effectiveness separately. One of the other ways that is suggested for presenting benefits within the context of costs is the Net Health Benefit (NHB) (Stinnett & Mullahy, 1998). The NHB is a measure of the effect, utility, or consequence. Stinnett & Mullahy (1998) define NHB as:  $NHB = \frac{\mu_E - \mu_C}{\lambda}$  whereas  $\mu_E$  is the mean effect of the intervention,  $\mu_C$  is the mean cost.  $\lambda$  is the Willingness to Pay (WTP) concept that is implicitly discussed in the context of the cost-effect diagram relevant to the family of cost effectiveness measures, but in the NHB context becomes explicit in the presented equation. The value for the NHB is calculated as  $NHB = (E_1 - E_0) - \frac{(C_1 - C_0)}{\lambda}$ .

The ICMC does not include the NHB measure, due to the unfamiliarity of the MC DHHS administrators with the measure. It may be of more use in future studies. summarizes the properties of Cost, Cost-Benefit, Cost-Effectiveness, Cost-Utility, Cost-Consequence, and Net Health Benefit. In the absence of using the NHB, the ICMC can improve the understanding its results by simply reporting costs and consequences separately in the case of a negative ICER.



**Table 6.2- A summary of cost and effect measures**

Measure	Definition – Unit	Point Estimate
Cost	A measure of the value of money that has been used up to produce a unit of something, and hence is not available for use anymore. Measured in USD.	$C_2 - C_1$
Cost-Benefit	A sum that measures the value of money that has been used up to produce a unit of something, compared to value of the money gained from the production of the same thing. Measured in USD.	$(C_2 - B_2) - (C_1 - B_1)$
Cost-Effectiveness	A fraction that compares the costs and outcomes and the outcome is measured in objective natural (SI) physical units.	$\frac{C_2 - C_1}{E_2 - E_1}$
Cost-Utility	A fraction that compares the costs and outcomes and the outcome is measured in subjective units such as Quality Adjusted Life Years (QALY).	$\frac{C_2 - C_1}{U_2 - U_1}$
Cost-Consequence	A fraction where the numerator is costs the denominator is a process indicator measured in subjective units.	$\frac{C_2 - C_1}{Con_2 - Con_1}$
Net Health Benefit	A measure of a health related effect, utility, or consequence, that considers the cost of production.	$(E_1 - E_0) - \frac{(C_1 - C_0)}{\lambda}$

(Stinnett & Mullahy, 1998)

Finally, it would be a stretch of imagination to claim that the first version of any model is unbiased. Given the limitations that Lehmann (2014) points to, some of which Question 7 discusses, some of the inputs that feed the ICMC have shortcomings. These shortcomings result in biases, which obviously influence the ICMC outputs, and in most cases may underestimate the costs of implementing interoperability. The robustness and flexibility of the ICMC allows for future changes as better inputs arrive.

## Specific strengths and shortcomings of the ICMC

### ICMC strengths

The ICMC is robust in its utility, since it can be easily modified to fit the needs of decision makers and the results of its analysis can be easily used for practical managerial decision making on interoperability, and the steps leading up to interoperability. The ICMC not only provides numerical results that empower decision making, it also provides feedback on which segments of the interoperability project are most vulnerable to exceed their costs, and will require more supervision during implementation.

**Table 6.3- Comparison of original ICMC results from various perspectives**

		Higher Value				Lower Value	
Client	<b>Value Difference</b>	Homeless adult	Aging out of disability programs	Aging out of foster care	Homeless youth	Pregnant teen	<b>Homeless family</b>
	<b>Cost-Benefit</b>	Aging out of foster care	Homeless youth	Pregnant teen	Aging out of disability programs	Homeless family	Homeless adult
Direct	<b>Value Difference</b>	Homeless adult	Pregnant teen	Aging out of disability programs	Aging out of foster care	Homeless family	Homeless youth
	<b>Cost-Benefit</b>	Homeless adult	Pregnant teen	Aging out of foster care	Aging out of disability programs	Homeless youth	<b>Homeless family</b>
Indirect	<b>Value Difference</b>	Homeless youth	Homeless adult	Pregnant teen	Homeless family	[Aging out of foster care]	[Aging out of disability programs]
	<b>Cost-Benefit</b>	Homeless youth	Pregnant teen	Aging out of foster care	<b>Aging out of disability programs</b>	<b>Homeless family</b>	<b>Homeless adult</b>
Total	<b>Value Difference</b>	Homeless Adult	Pregnant teen	Aging out of disability programs	Aging out of foster care	Homeless youth	Homeless family
	<b>Cost-Benefit</b>	Homeless adult	Pregnant teen	Aging out of foster care	Homeless youth	Aging out of disability programs	Homeless family

The ICMC results also allow for further analysis. It provides value results from the perspective of the client, the direct social perspective, and the indirect social perspective,

which managers can combine in a rank-order of value difference and cost-benefit difference. The result is Table 6.3 in which higher values are on the left and lower values are on the right, allows for a quick comparison of perspective and programs for decision-making purposes. This form of rank ordering is a demonstration of the types of further analysis the ICMC empowers. By using the ICMC to analyze their interoperability data, not only do managers receive information on the strengths and weaknesses of their organization, but the analysis provided by the ICMC guides managers towards asking the relevant questions on which they need further information for informed decision-making.

### **ICMC shortcomings**

The SROI model for Interoperability, and the resulting ICMC, suffers from several weaknesses that may make the validity of the ICMC and its outcomes questionable. Some of these shortcomings, and suggestions for future studies to overcome them, were previously discussed and included:

- Comparison of a “social life” to a “physical life” without providing sufficient evidence on comparability
- Failing to capture the perspective of the client may lead to observation bias
- Lack of specificity in the broad generalization of mental health in the persona, and lack of its consideration in the model.

Other shortcomings are discussed below.

#### **A- Defining the impact specifically**

The Cresswell et al (2006) framework, which is the theoretical framework of this study, defines impact as:

*“The framework recognizes four basic kinds of public value generators, listed below, each with a different range of measurements and implications for assessment:*

*Increases in efficiency – obtaining increased outputs or goal attainment with the same resources, or obtaining the same outputs or goals with lower resource consumption.*

*Enablement – providing means or allowing otherwise infeasible or prohibited desirable activity, or preventing or reducing undesirable events or outcomes.*

*Increases in effectiveness – increasing the quality and/or quantity of the desirable thing*

*Intrinsic enhancements – changing the environment or circumstances of a stakeholder in ways that are valued for their own sake” (Cresswell, et al., 2006).*

While it can be argued that interoperability affects all of the above for the outcomes defined by MC DHHS (Housing, Education, Employment, Access to Healthcare, and Personal Connections), more specificity is needed to define when an outcome is truly an outcome. It is not specifically clear, for example, how many units of housing does a DHHS need to increase in order to realize an impact on efficiency.

## **B- Classical threats to validity**

The predictive modeling study design of the ICMC makes it vulnerable to several classical threats to validity (Campbell & Stanley, 1966). Some of the most important threats that may distort attributing the change in the probability of Spiraling Up or Spiraling Down under As Is and To Be to the interoperability program are:

**History-** As a dynamic department MC DHHS is constantly experimenting with various interventions to improve the status of its clients. The outcomes of some of these interventions may specifically interfere in a synergetic or antagonistic way with the Spiraling Up or Spiraling Down process that this study defines. In this case, the effects of interoperability may be over or underestimated. Question 3 of the critique of the ICMC in this Chapter, for example, presented the case of the QSR intervention that is proceeding in MC DHHS, regardless of whether interoperability is implemented or not. Therefore, when

both programs are completed, it may prove difficult to separate and hone into the effects of each program separately.

**Maturation** – As time passes, the social workers, healthcare providers, educators, and other DHHS staff may gain more experience at their job, and may become better at assessing and delivering to the needs of the client, regardless of interoperability, and instead managers may contribute these efficiencies to interoperability.

**Selection bias** – As described, the clients that have been selected for this intervention are the clients that are the most difficult for MC DHHS to service, and have the highest costs of services among all the clients MC DHHS serves. A confounding factor (for example mental health) that influences both the clients and their outcomes (Spiral Up / Down) may be affecting this specific group of clients more than others and hence influencing the outcomes independent of interoperability.

**Statistical regression** – Once again, as these clients are the most difficult clients of MC DHHS, it could be that short of a fatal outcome, their situation cannot get any worse than it is. This leaves the probability of Spiraling Down and Spiraling Up unequal. As a result, their improvement over time may be due to the fact that independent of interoperability they are improving due to chance alone.

### **C- Lack of the standardization of spiraling (up or down)**

This model was unable to define a standardized definition and the units of spiraling up and down. It defines spiraling as a dichotomous variable (up or down) while in real life economics spiraling is a continuous variable (defined as percentage above or below the poverty line).

**Table 6.4- Spiral condition comparison for two personas**

<b>Persona</b>	<b>Stakeholder Description</b>	<b>Spiral Up</b>	<b>Spiral Down</b>
Aging out of foster care	17 years old, mental health, physical disabilities, developmental disabilities, reside in group home	Supported housing Working minimum wage In maintenance health care	Homeless or in a residential institution Unemployed
Pregnant teen	16 years old, in high school, failing in school, 1st child, single parent, previous trauma (sexual abuse), highly dysfunctional family, housing is tenuous	Supported housing Completes high school (or GED) Works, with child care support Mental health continued support Low likelihood of second infant	Homeless Unemployed Liable to lose children to foster care

The comparison of two personas illustrates this lack of standardization. As an example, Table 6.4 gives the definition of spiraling for two personas. From Table 6.4, it would be difficult to compare the value of “supported housing” and “unemployed” for the client who is aging out of foster care. More difficult would be to compare the value of “supported housing” between a client who is aging out of foster care and a pregnant teen client. Comparing the value of “in maintenance healthcare” and “works with child care support” is of even greater difficulty.

#### **D- Under calculation of the value of personal connection and social mobility**

Under the theory of social justice (Rawls, 1971), there is an assumption that there is an indirect benefit in a society or community where there is more economic opportunity for growth. It is assumed that in these societies these societies, the trust people have in each other is higher, and due to this trust more economic transactions take place and hence the whole society becomes wealthier (Chetty, et al., 2014). However, few quantitative studies are available on this subject. As part of this study the literature reviewed on social capital (Noll, 2002), connectedness (Grossman & Bulle, 2006), and belonging (Brooks, Magnusson, Spencer, & Morgan, 2012), connectedness was also identified as a risk (causative factor) for outcomes. In addition, this study did consider cell phone hours (and their cost) as a potential indicator of social connectedness. However, even though 62% of homeless youth have cell phones, their use is more instrumental (scheduling) than social, which would be a sign of connection. Furthermore, cell phone ownership and use, while high, does not correlate with depression, which suggests it is not a good indicator for permanent connections (Rice, et al., 2011).

## Summary of major strengths and weaknesses

1- The major strength of this dissertation was its feasibility and timing. The implementation of the interoperability project in MC DHHS is still recent and about to begin. This provided a major opportunity for implementing and the completion of this study.

2- The need for an independent evaluation of HIT systems is also a strength of this study. The expansion of HIT systems is starting to accelerate now with the growth of meaningful use (Blumenthal & Tavenner, 2010), while independent evaluations of HIT systems are indeed rare and much in need and demanded from within the policy making community (Shekelle, et al., 2006). This study may contribute to fulfilling part of this need.

3- Given that the field of HIT evaluation is so young, the models and conceptual frameworks needed for such evaluations are still rare and in development. The models developed for this study may all fulfill part of this increasing need.

4- Another strength of this study was its easy to understand and simple design. However, this can also be the most significant weakness of this study, which, is its design as a modeling study. At this time, a randomized clinical (community) trial, or even a quasi-experimental design would not have been feasible. In the future, if additional funding and time (or human resources) becomes available a case-control study with another county as the control group, would perhaps be feasible. The current design, nonetheless, may suffer from known potential threats to its validity such as History, Maturation, and Selection Bias as discussed. It also may fail to be generalizable to other settings beyond MC DHHS, due to problems with Selection Interactions.



## **Suggestions for future studies**

One of the most difficult challenges of this study was attempting to compare the value of a year of social life to the value of a year of real life. As previously mentioned, standardized outcomes in the field of social outcomes research are not as developed as in medicine. Sociological studies with the objective of classifying social virtues and vices, and assessing their benefits and burden would enrich the field of human services as well.

As experienced during the course of this study, the use of personas is a beneficial method to enrich and deepen the conversation between the various levels that work in delivering and improving human services. However, since the personas are not standardized and validated they can easily lead to bias, and hence a wrong assessment of the problems the actual clients face.

Along with the standardization of the personas, future studies should clearly specify the mental health conditions and diagnosis of the personas. Psychiatric epidemiological studies, which can provide the data for this purpose, have been long available (Kessler, et al., 1994; Robins & Regier, 1991) and are improving continuously (Elhai & Ford, 2007). Furthermore, with the clarification of exact conditions and diagnosis of the persona, available cost-benefit studies on the treatments for the conditions, can be more readily utilized in future studies (WSIPP, 2014).

In combining the first two suggestions from above, standardization of the states of Spiral Up and Spiral Down is also a priority for future studies. The specific question that today remains unanswered is what combination of services the client needs to become sustainably independent of the welfare system with less risk of future recidivism. These studies should be done while keeping in mind the question of eligibility. Today the eligibility criterion for most human services is a dichotomous variable and based on one or two

conditions. It is the hope that parallel with the development of interoperability, and specifically the Intensive Teaming Protocols, discussions of eligibility will develop to include a broader range of the continuous spectrum of human conditions they serve. Such discussions are already finding their way into tools similar to the ICMC for executive decision making (Low Income Investment Fund (LIIF), 2014).

Finally, this study found a large and even contradictory gap in the literature on the value of personal connections and its contribution to health. In one study connectedness was also identified as a risk (causative factor) for outcomes (Grossman & Bulle, 2006). This study did consider cell phone hours (and their cost) as a potential indicator of social connectedness. However, even though 62% of homeless youth have cell phones, their use is more instrumental (scheduling) than social, which would be a sign of connection. On the other hand, cell phone ownership and use, while high, does not correlate with depression, which suggests it is not a good indicator for permanent connections (Rice, et al., 2011). With the increasing use of social media in the form of various internet and mobile-based social networking mediums, more data will flow from these sites, which will surely provide some useful raw material for future studies.

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# Appendix

## IRB Exemption of Human Subjects Research Approval

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FWA #00000287

### JHSPH Institutional Review Board Office

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### NOT HUMAN SUBJECTS RESEARCH DETERMINATION NOTICE

**Date:** October 21, 2013

**To:** Harold Lehmann, MD, PhD  
(Babak Mohit)  
Department of Health Policy & Management

**Re:** **Study Title:** "A Social Return on Investment (SROI) analysis of human services interoperability in Montgomery County, MD"  
**IRB No:** 00005393

The JHSPH IRB reviewed the above-referenced new application on **October 17, 2013**. We have determined that the proposed activity described in your application involves subjects who are key informants and collects expert opinions and judgments designed to elicit information from them in their professional capacity about the Process Technology and Modernization (PTM) project. Data will be anonymous and will not include any personal or private information. Thus, the proposed activity does not qualify as human subjects research as defined by DHHS regulations 45 CFR 46.102, and does not require IRB oversight.

You are responsible for notifying the JHSPH IRB of any future changes that might involve human subjects and require IRB oversight.

If you have any questions regarding this action, please contact the JHSPH IRB Office at (410) 955-3193 or via email at [irboffice@jhsp.h.edu](mailto:irboffice@jhsp.h.edu).

AS/teb

## Evidence Table 1

**Table 0.1- League table of theoretical papers**

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Althaus, et al., 2011)	worldwide	systematic rev, cost analysis	Our objective is to perform a systematic review of the type and effectiveness of interventions to reduce the number of ED visits by frequent users.	We searched MEDLINE, EMBASE, CINAHL, PsychINFO, the Cochrane Library, and ISI Web of Science for randomized controlled trials, nonrandomized controlled trials, interrupted time series, and controlled and noncontrolled before-and-after studies describing interventions targeting adult frequent users of EDs. Primary outcome of interest was the reduction in ED use. We also explored costs analyses and various clinical (alcohol and drug use, psychiatric symptoms, mortality) and social (homelessness, insurance status, social security support) outcomes.	Frequent users of emergency departments (EDs)	<p>We included 11 studies (3 randomized controlled trials, 2 controlled and 6 noncontrolled before-and after studies).</p> <p>Heterogeneity in both study designs and definitions of frequent users precluded meta-analyses of the results. The most studied intervention was case management (n 7).</p> <p>Only 1 of 3 randomized controlled trials showed a significant reduction in ED use compared with usual care. Six of the 8 before-and-after studies reported a significant reduction in ED use, and 1 study showed a significant increase. ED cost reductions were demonstrated in 3 studies. Social outcomes such as reduction of homelessness were favorable in 3 of 3 studies, and clinical outcomes trended toward positive results in 2 of 3 studies.</p>	Frequent users of emergency departments (EDs)	treatment	Case Management	Case Management seems to lead to lower costs and better outcomes across the studies

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Bassuk & Geller, 2006)	USA	literature review	<p>This article reviews what is known about the role of housing and services in reducing family homelessness.</p> <p>People in families comprise 33 percent of the homeless population, but few resources are available to fully meet their needs. Some researchers have suggested that the vast majority of these families do not need services and that housing vouchers alone can end most family homelessness.</p>			<p>The literature on the effects of housing subsidies and services on homeless families is limited compared with the literature on homeless individuals. Evidence suggests that access to housing vouchers seems to increase residential stability and that case management and other services also contribute to residential stability and other desirable outcomes, including family preservation and reunification.</p>	homeless	housed	no single outcome found	

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Béchar, Ireland, Berg, & Vogel, 2011)	California	retrospective cohort	examine the appropriateness of the actual juvenile population serviced in comparison with the declared and described programs' target populations.	simple count	youth with offenses	A closer look at the nature of the charges that led to the youths' entrance into YDP found that juveniles had not really committed very serious offenses; most of their behaviors could be classified as more mischievous than criminal. It seems clear that YDP has cast a very wide net to capture sufficient numbers of youth to ensure its continued existence as a diversion program. It seems unlikely that the YDP efforts actually have very much to do with diverting most of these juveniles from further or additional penetration into the juvenile or criminal justice systems. It remains unclear, however, whether these youth were genuinely at risk of delinquency or merely involved in episodic youthful mischievous behavior that would have aged out with maturity.	youth with offenses	youth with offenses in the YDP		

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Best & Young, 2009)	USA	review paper/ guidelines	Homeless patients suffer disproportionately from medical disease and from barriers to healthcare, affecting their likelihood of presentation, severity of disease, long-term outcomes, and mortality. In the hospital, homeless patients are frequently cared for by hospitalists. Homeless patients' unstable social situation may challenge usual systems of inpatient care and discharge.	N/A	Homeless patients	To provide more effective care for this group, it is important to recognize the demographics of the hospitalized homeless patient. We suggest a structured approach to the inpatient care of the unstably housed patient, represented by a simple mnemonic checklist "A SAFE DC," describing evidence-based adaptations of care, where available, and discussing systems-based approaches to discharge.	Homeless sick	homeless treated	Preventative Services to Consider for Homeless Inpatients	Vaccines: hepatitis A and B, influenza, Pneumococcus, Td Tobacco abuse: cessation counseling and resources Substance abuse: information regarding needle exchange programs, social work consultation for treatment options Tuberculosis: consider screening with PPD ( spot sputum for AFB) Sexual behavior: counseling on safer sex practices and STD risk tic and street violence: social work consultation for counseling and resources Mental health: depression screening, MMSE
(Blau, et al., 2010)	California, New York, Indiana	Review	Examples are presented of successful state, community, and provider practice changes, and available tools and resources to support all constituencies in achieving positive outcomes.	Descriptive	The Building Bridges Initiative (BBI) provides a framework for achieving positive outcomes for youth and families served in residential and community programs.	Program Description	youth with mental health problems	youth with mental health problems treated under BBI	None	

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Bruns, et al., 2010)	United States	Review	In this paper, we provide a review of the place of the wraparound process in behavioral health, including a discussion of the opportunities it presents to the field, needs for further development and research, and recommendations for federal actions that have the potential to improve the model's positive contribution to child and family well-being.	Review	youth with complex behavioral health challenges and their families	it presents to the field, needs for further development and research, and recommendations for federal actions that have the potential to improve the model's positive contribution to child and family well-being	youth with mental health problems	youth with mental health problems treated under federally supported case management	None	See Bruns 2009 for systematic review: Bruns, E. J., Sather, A., Walker, J. S., Conlan, L., & LaForce, C. (2009). Impact of the National Wraparound Initiative: Results of a survey of NWI advisors. Portland, OR: National Wraparound Initiative, Portland State University
(Bruns & Walker, 2011)	United States	Introduction to discussion series		Review	youth with complex behavioral health challenges and their families		youth with mental health problems	youth with mental health problems treated under wraparound program	None	See Bruns 2009 for systematic review: Bruns, E. J., Sather, A., Walker, J. S., Conlan, L., & LaForce, C. (2009). Impact of the National Wraparound Initiative: Results of a survey of NWI advisors. Portland, OR: National Wraparound Initiative, Portland State University

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Crook, Mullis, Cornille, & Mullis, 2005)	Global	systematic rev	This article reviews the literature on outcome measurement in homeless systems of care, grounded in a conceptual model consisting of three elements: continuums of care, service programs, and clients.	Literature Rev	Homeless	<p>This review did not reveal the existence of any single comprehensive outcome measurement instrument that could be used for the homeless system of care. System-level outcomes include cost savings, reduction of access barriers, and organizational linkages. Service program-level outcome measurement is typically based on the aggregation of client-level outcomes. At the client-level of measurement, several instruments were identified in the literature that have potential for providing the basis of outcome measurement.</p>	Homeless	Homeless	<p>A standardized evaluation tool would assist both service providers and governmental stakeholders in their efforts to assess the achievement of the primary goal of the Continuum of Care—reduction of homelessness. Although there were no system-level outcome measurement tools, potential system-level outcomes include demonstrated cost savings across systems; reduction of barriers to access; networking among community organizations; and aggregation of client-level outcomes.</p>	<p>Service program-level outcome measurement is typically based on the aggregation of client-level outcomes can include days of reduced substance use; increased days housed; improved employment status; improved family and social functioning; increased income; decreased risk behaviors; improved mental health status; and increased client participation and engagement. At the client-level of measurement, several instruments were identified that have potential for providing the basis of outcome measurement. The establishment of validity, reliability, and norms for standardized instruments enable evidence-based practice by documenting the effectiveness of social interventions in terms of positive changes in the target population. These reflect a wide scope of client outcomes, including improvements in addiction recovery, instrumental functioning, depression, interpersonal support, and partner violence.</p>



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Davis, Tamayo, & Fernandez, 2012)	San Francisco, CA	qualitative interviews	Case management programs for chronically ill, homeless people improve health and resource utilization by linking patients with case managers focused on improving management of medical and psychosocial problems. Little is known about participants' perspectives on case management interventions.	This qualitative study used in-depth, one-on-one interviews to understand the impact of a case management program from the perspective of participants. A standardized interview guide with open-ended questions explored experiences with the case management program and feelings about readiness to leave the program.	chronically ill, homeless people	Four recurrent themes emerged: (1) Participants described profound social isolation prior to case management program enrollment; (2) Participants perceived that caring personal relationships with case managers were key to the program; (3) Participants valued assistance with navigating medical and social systems; and (4) Participants perceived that their health improved through both the interpersonal and the practical aspects of case management.	Mental Health Homeless	Mental Health cared	N/A	N/A

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Herrman, et al., 2004)	Melbourne, Australia	This was a two-stage nested study	The prevalence of psychosis and needs for care among homeless people were studied in inner Melbourne.	This was a two-stage nested study within the Australian National Survey of People Living with Psychotic Illness. A screen for psychosis was administered to a representative sample of men and women living in marginal housing in a mental health service catchment area. A selected subsample of 82 screen-positive respondents was interviewed using the Diagnostic Interview for Psychosis (DIP), a semistructured, standardized interview with three modules: (i) demography, functioning and quality of life; (ii) diagnosis; and (iii) service use.	psychosis and needs for care among homeless people	An unexpectedly high prevalence of people living with psychotic disorders (estimated lifetime prevalence 42%, 95% CI = 37–47%) may reflect a concentration of vulnerable people in the shrinking marginal housing supply in the inner city areas. Disability in everyday, occupational and social functioning is greater for this subgroup than for other people living with psychosis in Australia. Most people were single and unemployed, and many reported social isolation and feeling unsafe. Substance use disorders were common. Most people were using health services, including specialist mental health services, but few were receiving rehabilitation, vocational or housing support.	Homeless Mental Health	Mental Health	descriptive statistics (not analytical) in the form of percentages are reported	Despite high levels of contact with a well-organized, sectorized mental health service in an affluent country, this pocket of several hundred people had high levels of persisting disability and needs. The literature and local experience suggest that changing this situation is likely to require co-ordinated policy and practice between the health, welfare and housing sectors.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Herman & Harvey, 2005)	Melbourne, Australia	Opinion paper literature review	To encourage follow-up studies of programs and interventions assessing a range of outcomes in local settings and their relation with homelessness and mental health	Opinion paper literature review	homelessness and mental health	<p>People with psychosis living in developed countries in the era of community-based care are likely to be socially isolated, unemployed, and have poor quality of life, despite recent advances in the treatment and understanding of psychosis. Recent work in Australia illustrates the needs for care, especially for those with complex disabilities, and even for those in contact with well-organized clinical mental health services. Insufficient evidence in two key areas impedes progress: the use of effective psychosocial interventions; and the impact of changes in the community care system.</p> <p>Follow-up studies of programs and interventions assessing a range of outcomes in local settings are now required to encourage professionals and the community to address these needs.</p>	Homeless Mental Health	Mental Health	N/A	N/A

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Owen-Jones, et al, 2013)	UK	N/A	To evaluate the Family Nurse Partnership programme introduced in England by the Department of Health in 2006 with the aim of improving outcomes for the health, wellbeing and social circumstances of young first-time mothers and their children.	RCT	pregnant teens	study protocol	pregnant teens	pregnant teen with care	Four primary outcomes are to be reported from the trial: birth weight; prenatal tobacco use; child emergency attendances and/or admissions within two years of birth; second pregnancy within two years of first birth.	N/A
(Standliffe & Keane, 2000)	Sydney, Aus	paired t-test	Consumer outcomes and recurrent (non-capital) service costs were compared for matched groups of Australian adults with intellectual disability living in group homes or semi-independently.	Through interviews outcomes examined included quality of life, safety, aloneness, social dissatisfaction, personal care, domestic management, health care, money management, social network, use of mainstream community services, community participation, domestic participation, stability of place of residence, living companion turnover, and natural support.	41 Residents from 13 government and non-government accommodation support agencies participated.	Most outcomes did not differ significantly by group. Where significant differences were evident, participants living semi-independently experienced better outcomes: significantly less social dissatisfaction, more frequent and independent use of community facilities, more participation in domestic tasks, and greater empowerment. There were no outcomes with significantly better results for group home participants. The lower level of staffing provided to semi-independent participants was not associated with poorer outcomes.	Subsidised Housing	Subsidised Housing Happy	Quality of Life Questionnaire	Various

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Dickey, 2000)	Global	literature review/ descriptive	It is estimated that 25% of homeless persons have a serious mental illness. It is challenging to determine whether the programs are cost-effective. Since public resources are used to maintain services for the homeless mentally ill, policy-makers must be informed about whether the best outcomes are achieved at the lowest possible cost.	This article will review the literature evaluating prevention services and specialized outreach, treatment, and housing programs designed to reduce homelessness for individuals who are mentally ill.	homeless individuals who are mentally ill.	Following a discussion of the successes of the individual programs and the challenges they confront, several important questions are identified related to improving the efficiency of these programs. Although the establishment of such programs indicates that progress has been made toward alleviating the burdens facing people who are homeless and mentally ill, collaboration among all stakeholders—especially between the mental health community and consumer advocates—needs to be further enhanced. New research can be conducted in a way that improves how information is evaluated and used.	Mentally Ill & homeless	Mentally Ill & housed	N/A	N/A

## Evidence Table 2

**Table 0.2- League table of cost papers**

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Alimohamed-Jannohamed, Charvat, Gheyntachi, Beutler, & Breckenridge, 2010)	Santa Barbara County Mental Health Services, CA	logistic regression	This study examines point of entry, functional impairment, comorbid diagnosis, and demographic variables as predictors of treatment amount and cost for patients with mental illness and substance abuse disorders.	retrospective cohort	patients with mental illness and substance abuse disorders.	Overall, significant results were found for point of entry, with higher costs associated with mental health than chemical abuse point of entry. Furthermore, amount, modality, and cost of service varied widely across such variables as functional impairment with those rated as least impaired receiving the greatest amount of services at the greatest cost. Additional significant findings in treatment amount and cost are reported for variables such as homelessness, ethnicity, and age.	patients with mental illness and substance abuse disorders.	patients with mental illness and substance abuse disorders receiving care	\$	Costs ranging from an average of \$8886 if the second epoch is different from first to an average of \$1842 if first contact for Drug Abuse rather than MH. Odds Ratios for costs, time used, and ammount of service use are also given.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Barnet, et al., 2010)	5 urban clinics that provide care to low income African American communities	Cost effectiveness/ Logistic Regression	To determine the cost-effectiveness of an intervention that successfully reduced rapid repeated births within 2 years of an index birth to adolescent mothers.	RCT	At risk teen females in African American communities	Relative to usual care, CAMI [Computer Assisted Motivational Intervention] significantly reduced repeated births (adjusted odds ratio, 0.47; 95% confidence interval, 0.22-0.97). Mean intervention costs per adolescent were \$2064, with incremental cost effectiveness ratios per prevented repeated birth of \$21 895 (unadjusted), \$17 388 (adjusted), and \$13 687 for a highrisk subgroup termed newly insured (eligible for but not enrolled in public insurance).	At risk teen females	Educated teen females	\$/ female Odds Ratio	Relative to usual care, CAMI significantly reduced repeated births OR = 0.47. Mean intervention costs per adolescent were \$2,064, with incremental costeffectiveness ratios per prevented repeated birth of \$21,895, and \$13 687 for a highrisk subgroup termed newly insured (eligible for but not enrolled in public insurance).

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Bensusen-Walls & Saewyc, 2001)	University of Washington Medical Center & Group Health Cooperative	Cost effectiveness/ t-test	to compare outcomes and cost-effectiveness of comprehensive, interdisciplinary teen-centered prenatal care clinics (Young Women's Clinic & Teen Pregnancy and Parenting Clinic) with "traditional" adult-centered obstetric services	retrospective, matched-case comparison study	pregnant teens	Findings showed that teen-clinic clients missed fewer appointments (0.96 vs. 2.29, $p < 0.05$ ), were more likely to be enrolled in the supplemental Medicaid program First Steps ( $p < 0.001$ ) and WIC ( $p < 0.01$ ), were more likely to have vaginal deliveries (90% vs. 75%, $p < 0.05$ ) and higher birth weight infants (3330 vs. 3084 g, $p < 0.05$ ), and were more likely to attend 2-week ( $p < 0.001$ ) and 6-week postpartum exams ( $p < 0.05$ ). Postpartum data were missing for the majority of adult-clinic subjects; teen-clinic postpartum outcomes included high contraception rates (87.5%), breastfeeding (62%), school return postpartum (63%), and long-term follow-up. Costs were lower for teen clinics based on outcomes; cost savings related to preterm labor were similar.	Preganant teen	Preganant teen who receives prenatal care	\$/mother child \$/preterm birth avoided	Cost saving of YWC/GHC over GHC = 6122 - (4877 or 4584) Cost saving of preterm birth avoided = 59488 - (23866 or 14989)



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Bloom, et al., 2004)	Northeast Florida	descriptive statistics	The purpose of this study was to explore and describe the barriers to prenatal care for homeless pregnant women.	A descriptive survey with written questionnaires.	About 183 pregnant homeless women live in Northeast Florida in any given month. More than 250 surveys were distributed to homeless pregnant women via agencies that provide shelter and/or services to homeless people in Northeast Florida. Forty-seven surveys were returned, representing 25.7% of the estimated population.	Of the respondents, 75.61% perceived barriers to prenatal care. Site-related factors were the most significant, followed by provider/client relationship, inconvenience, fear, and cost.	Homeless Pregnant	Homeless Pregnant with prenatal care	Barriers to prenatal care were measured using Melnyk's Barriers Scale, a 27-item Likert-type scale.	Of the respondents, 75.61% perceived barriers to prenatal care. Site-related factors were the most significant, followed by provider/client relationship, inconvenience, fear, and cost.
(Brandon, 1999)	United States	N/A	Book Review	N/A	pregnant teen	Maynard in the final chapter estimates that the costs of teen pregnancy to U.S. taxpayers amount to almost \$7 billion annually. Extrapolating further, she estimates that the cost to society in lost national productivity and avoidable expenditure of social service resources is as much as \$30 billion annually.	pregnant teen	pregnant teen	\$/pregnant teens	Maynard in the final chapter estimates that the costs of teen pregnancy to U.S. taxpayers amount to almost \$7 billion annually. Extrapolating further, she estimates that the cost to society in lost national productivity and avoidable expenditure of social service resources is as much as \$30 billion annually.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Buck, Brown, Mortensen, Riggs, & Franzini, 2012)	Harris County, Texas'	retrospective cohort	Homeless individuals have mortality rates three to six times higher than their housed counterparts and have elevated rates of mental illness, substance abuse, and co-morbidities that increase their need for health services. Data on the utilization of Harris County, Texas' public hospital system by 331 homeless individuals and a random sample of 17,824 domiciled patients were obtained from June 2008 to July 2009.	Data on the utilization of Harris County, Texas' public hospital system by 331 homeless individuals and a random sample of 17,824 domiciled patients were obtained from June 2008 to July 2009.	homeless individuals in Harris County, Texas' public hospital system	Homeless individuals had increased readmission rates, especially within 30 days of discharge, resulting in significantly higher total annual length of stay. Homeless patients also more frequently utilize public hospitals for mental illness and HIV. Lack of community health services contributes to an increased dependence and preventable over-utilization of public hospital systems. Case management interventions integrating primary and behavioral care into health homes, medical respite programs, and training for health care professionals who provide indigent care will improve health outcomes of this population and reduce costs.	Homeless sick	homeless treated	\$/patient	\$43,169 for domiciled vs \$86,474 for homeless

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(K. Cooper, et al., 2012)	United Kingdom	We developed an economic model to estimate the total number of STI cases averted, consequent gain in health related quality of life (HRQoL) and savings in medical costs based on changes in sexual behavior.	We evaluated the cost-effectiveness of school-based behavioral interventions to reduce sexually transmitted infections (STI) and teenage pregnancy in young people.	The parameters for the model were derived from a systematic literature search on the intervention effectiveness, epidemiology of STIs, sexual behavior and lifestyles, HRQoL and health service costs.	sexually unaware teen	The costs of providing teacher-led and peer-led behavioral interventions were Euros 5.16 and Euros18 per pupil, respectively. For a cohort of 1000 boys and 1000 girls aged 15 years, the model estimated that the behavioral interventions would avert two STI cases and save 0.35 Quality Adjusted Life Years (QALYs). Compared to standard education, the incremental cost-effectiveness of the teacher-led and peer-led interventions was Euros 24,268 and Euros 96,938 per QALY gained, respectively.	sexually unaware teen	sexually aware teen	Euro/QALY wrt change in preg/STI	Compared to standard education, the incremental cost-effectiveness of the teacher-led and peer-led interventions was Euros 24,268 and Euros 96,938 per QALY gained, respectively

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Culhane, Metraux, & Hadley, 2002)	New York City	Regression	This article assesses the impact of public investment in supportive housing for homeless persons with severe mental disabilities.	Data on 4,679 people placed in such housing in New York City between 1989 and 1997 were merged with data on the utilization of public shelters, public and private hospitals, and correctional facilities. A series of matched controls who were homeless but not placed in housing were similarly tracked.	homeless persons with severe mental disabilities.	Regression results reveal that persons placed in supportive housing experience marked reductions in shelter use, hospitalizations, length of stay per hospitalization, and time incarcerated. Before placement, homeless people with severe mental illness used about \$40,451 per person per year in services (1999 dollars). Placement was associated with a reduction in services use of \$16,281 per housing unit per year. Annual unit costs are estimated at \$17,277, for a net cost of \$995 per unit per year over the first two years.	Mental Health	Mental Health with housing	\$	Before placement, homeless people with severe mental illness used about \$40,451 per person per year in services (1999 dollars). Placement was associated with a reduction in services use of \$16,281 per housing unit per year. Annual unit costs are estimated at \$17,277, for a net cost of \$995 per unit per year over the first two years.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Culhane & Metraux, 2008)	Global	systematic rev	This article uses research on homelessness to devise alternative forms of emergency assistance that could reduce the prevalence and/or duration of episodes of homelessness and much of the need for emergency shelter.	We review analyses of shelter utilization patterns to identify subgroups of homeless single adults and families with minor children, and propose alternative program models aimed at the particular situations of each of these subgroups.	Homeless	We argue that it would be both more efficient and more humane to reallocate resources currently devoted to shelters. We propose the development of community-based programs that instead would focus on helping those with housing emergencies to remain housed or to quickly return to housing, and be served by mainstream social welfare programs. We advocate providing shelter on a limited basis and reserving transitional housing for individuals recently discharged from institutions. Chronic homelessness should be addressed by permanent supportive housing.	Homeless	Homeless	Volume in each transition stage as a linear function of Cost per case	Community based programs followed by rent assistance followed by supportive housing each have higher costs and lower number of people involved in them

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Culhane, Park, & Metraux, 2011)	Philadelphia	retrospective cohort	This study examines families' use of behavioral health hospitalization and foster care placement before, during, and after shelter use, comparing families based on shelter pattern and type of housing exit. RIP=Residential Instability Period	cost analysis	homeless persons with severe mental disabilities.	Results show that inpatient and foster care services use drops in the homelessness period, but rebounds after exit, regardless of pattern of shelter use and type of housing exit. Results suggest that shelters supplant use of services, but not on a sustained basis. Despite declines in concurrent services use, the homelessness period is overall more costly for episodically and long-term shelter users, primarily owing to the high costs of shelter. High rates of inpatient and foster care services use after the homeless spell suggest that providers of homeless assistance should systematically screen and refer homeless families to ongoing community-based service supports. Service use patterns indicate that homeless spells may disrupt continuity of care with community-based health and social services.	Mental Health	Mental Health with housing	\$/ residential instability period (RIP)	Highest costs (Housing + MH/SA treatment) accrue for the longstay group (\$31,501) followed by episodic group during an RIP (\$17,125). Lowest costs are for the longstay group (\$1,521) prior to a RIP.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Doran, Ragins, Gross, & Zenger, 2013)	Global	systematic review	Medical respite programs provide care to homeless patients who are too sick to be on the streets or in a traditional shelter, but not sick enough to warrant inpatient hospitalization. They are designed to improve the health of homeless patients while also decreasing costly hospital use. Although there is increasing interest in implementing respite programs there has been no prior systematic review of their effectiveness.	We conducted a comprehensive search for studies of medical respite program outcomes in multiple biomedical and sociological databases, and the grey literature.	homeless patients who are too sick to be on the streets or in a traditional shelter, but not sick enough to warrant inpatient hospitalization	Thirteen articles met inclusion criteria. The articles were heterogeneous in methods, study quality, inclusion of a comparison group, and outcomes examined. Available evidence showed that medical respite programs reduced future hospital admissions, inpatient days, and hospital readmissions. They also resulted in improved housing outcomes. Results for emergency department use and costs were mixed but promising.	homeless patients who are too sick to be on the streets	homeless	\$	only one study was designed primarily as a cost analysis. <sup>17</sup> This study was based on the Chicago Housing for Health Partnership randomized control trial of a comprehensive intervention including medical respite, case management, and placement in supportive housing. The authors found that the intervention group had average annual cost savings of \$6,307. The majority of the savings came from reduced hospitalizations (\$6,786 saved per year), though reduced emergency department visits, nursing home stays, and jail stays also contributed. The majority of the increased costs were for housing (\$3,154 per year), with other increases for outpatient visits and case management. Another study estimated that respite care cost \$706 for each hospital day avoided, which is slightly less than half the cost of one hospital day.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Frick, et al, 2004)	Baltimore, MD	Cost effectiveness Analysis	The objectives of this article are (1) to model the cost-effectiveness of the Experience Corps Baltimore using data from a pilot randomized trial, including costs, older adults' health status, and quality of life and cost data from the Medical Expenditure Panel Survey, and (2) to describe the relationship between children experiencing increased expected lifetime earnings through improved educational attainment resulting from exposure to the Experience Corps Baltimore volunteers and the program's costs and cost-effectiveness.	restrospective secondary data analysis	School childrenen tutored by adults	On average, each quality adjusted life year (QALY) gained by older adults in Experience Corps Baltimore costs \$205,000. The lower bound of the 95% confidence interval for the cost-effectiveness is \$65,000/QALY. The upper bound is undefined as 15% of the simulations indicated no QALY improvements. If 0.3% of students exposed to the Experience Corps Baltimore changed from not graduating to graduating, the increased lifetime earnings would make the incremental cost-effectiveness ratio \$49,000/QALY. If an additional 0.1% changed to graduating from high school, the program would becost-saving. Using conservative modeling assumptions and excluding benefits to teachers, principals, and the surrounding community, the Experience Corps Baltimore appears expensive for the older adults' health improvements, but requires only small long-term benefits to the target children to make the program cost-effective or cost-saving.	School childrenen	School childrenen with adult mentor	QALY or \$	On average, each quality adjusted life year (QALY) gained by older adults in Experience Corps Baltimore costs \$205,000. The lower bound of the 95% confidence interval for the cost-effectiveness is \$65,000/QALY. The upper bound is undefined as 15% of the simulations indicated no QALY improvements. If 0.3% of students exposed to the Experience Corps Baltimore changed from not graduating to graduating, the increased lifetime earnings would make the incremental cost-effectiveness ratio \$49,000/QALY.



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Gilmer, et al., 2004)	San Diego County, CA	Case Control Comparative Cost Analysis	This study examined mental health service utilization and costs associated with the California Assembly Bill 2034 housing-first program for homeless persons in San Diego County: Reaching Out and Engaging to Achieve Consumer Health (REACH).	Encounter data were used to identify REACH clients and a control group that was matched by propensity score. Mental health services costs for case management, outpatient services, inpatient and emergency services, criminal justice system services, and total services were summarized for two-year periods before and after clients initiated REACH. Incremental costs of the program were calculated as the difference in cost among clients in the REACH group, from pre- to postintervention, less the difference in cost among those in the control group from pre- to postintervention.	Participants in housing-first program for homeless persons in San Diego County: Reaching Out and Engaging to Achieve Consumer Health (REACH).	A total of 177 REACH clients and 161 clients in a control group matched by propensity score were identified. Among REACH participants, case management costs increased by \$6,403 ( $p<.001$ ) from pre- to postintervention, inpatient plus emergency services costs declined by \$6,103 ( $p=.034$ ), and costs for mental health services provided by the criminal justice system declined by \$570 ( $p=.020$ ) compared with the control group. The standardized difference-in-difference estimate of the total costs between REACH clients and the control group was not significant.	Homeless Mental Health	treatment	\$ propensity score	Among REACH participants, case management costs increased by \$6,403 ( $p<.001$ ) from pre- to postintervention, inpatient plus emergency services costs declined by \$6,103 ( $p=.034$ ), and costs for mental health services provided by the criminal justice system declined by \$570 ( $p=.020$ ) compared with the control group.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Gilmer, Stefancic, Ettner, Manning, & Tsemberis, 2010)	San Diego County, California, from October 2005 through June 2008.	Case Control Comparative Cost Analysis	Chronically homeless adults with severe mental illness are heavy users of costly inpatient and emergency psychiatric services. Full-service partnerships (FSPs) provide housing and engage clients in treatment. The objective of this paper is to examine changes in recovery outcomes, mental health service use and costs, and quality of life associated with participation in FSPs.	A quasi-experimental, difference-in-difference design with a propensity score-matched control group was used to compare mental health service use and costs of FSP with public mental health services. Recovery outcomes were compared before and after services use, and quality of life was compared cross-sectionally.	FSP clients and clients receiving public mental health services.	Among FSP participants, the mean number of days spent homeless per year declined 129 days from 191 to 62 days; the probability of receiving inpatient, emergency, and justice system services declined by 14,32, and 17 percentage points, respectively; and outpatient mental health visits increased by 78 visits (P .001 each). Outpatient costs increased by \$9180; inpatient costs declined by \$6882; emergency service costs declined by \$1721; jail mental health services costs declined by \$1641; and housing costs increased by \$3180 (P .003 each). Quality of life was greater among FSP clients than among homeless clients receiving services in outpatient programs.	mental patient	hospitalized	Recovery outcomes (housing, financial support, and employment), mental health service use (use of outpatient, inpatient, emergency, and justice system services), and mental health services and housing costs from the perspective of the public mental health system.	Among FSP participants, the mean number of days spent homeless per year declined 129 days from 191 to 62 days; the probability of receiving inpatient, emergency, and justice system services declined by 14,32, and 17 percentage points, respectively; and outpatient mental health visits increased by 78 visits (P .001 each). Outpatient costs increased by \$9180; inpatient costs declined by \$6882; emergency service costs declined by \$1721; jail mental health services costs declined by \$1641; and housing costs increased by \$3180 (P .003 each). Quality of life was greater among FSP clients than among homeless clients receiving services in outpatient programs.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Greenwood, 2008)	Not Specified	systematic review	According to Greenwood, researchers have identified a dozen "proven" delinquency-prevention programs. Another twenty to thirty "promising" programs are still being tested. In his article, Greenwood reviews the methods used to identify the best programs, explains how program success is measured, provides an overview of programs that work, and offers guidance on how jurisdictions can shift toward more evidence-based practices	systematic review	child without supervision	The most successful programs are those that prevent youth from engaging in delinquent behaviors in the first place. Greenwood specifically cites home-visiting programs that target pregnant teens and their at-risk infants and preschool education for at-risk children that includes home visits or work with parents. Successful school-based programs can prevent drug use, delinquency, anti-social behavior, and early school drop-out.	child without supervision	child supervised under program	Cost/benefit	35 programs and cost benefit given for most. Most programs for institutionalized children. For group or Foster care Children Multi-Dimensional Foster Care Treatment is evaluated and has a cost \$6945 and CBR of 12.2 [Benefit=Criminal Justice savings + Victim savings]

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Harburger & White, 2004)	50 United States	Cost Calculation	This article presents recommendations for costeffective housing-child welfare partnerships that will shift the burden of providing adequate housing back to housing agencies.	Cost Calculation	Homless and Child welfare receipients	<p>It costs \$2.76 billion per year to maintain 30% of children in foster care with supportive services. In contrast, it costs \$816 million per year to subsidize just the 30% of children in foster care and their families in housing while also providing supportive services. The cost of supportive housing is 70% less than the cost to maintain children in foster care.</p> <p>Savings could amount to more than \$1.94 billion per year or \$31,964 per family.</p> <p>Given the effectiveness of supportive housing programs both in terms of cost and the ASFA indicators, it seems only logical to suggest the establishment of a partnership between child welfareand housing agencies to share the burden of housing and providing services to families and children. On average, a worker needs to earn \$15.21 per hour to afford a two-bedroom apartment The median hourly wage nationally is \$8.94 for a security guard, \$9.37 for a file clerk, and \$12.50 for a word processor</p>	Homeless child in fostercare	Child reunited with housed family	\$ probability of homelessness	<p>the average family in the child welfare system has 2.7 children. The average annual cost to the United States of keeping the children of one family of this size in foster care is approximately \$45,377. The average starting salary in 1996 for investigative social workers was \$12.15 per hour. Even casework supervisors do not earn much more than is needed to afford a two-bedroom apartment at \$15.22 perhour. As a result of the housing affordability crisis, 4% to 6% of America's poor become homeless each year.</p> <p>Homeless families with children now represent 41% of the homeless population, 95% of homeless parents are female. The contracts for supportive housing pay for themselves: Supportive housing for the chronically homeless is cost neutral at six months into the program, with expected savings after that, and the total number of out-of-home placements and casework hours are reduced as well</p>

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Harkness, Newman, & Salkever, 2004)	in four cities that participated in the 1986–91 Robert Wood Johnson Foundation Program on Chronic Mental Illness (RWJF–PCMI)		Although persons with serious mental illness experience significant unmet housing needs, basic information on how housing is successfully financed, developed, and operated for them is lacking. It is possible that standard housing rules of thumb may not apply to this population. (For example, community opposition may raise development costs.) This lack of information may be a stumbling block to policy makers, planners, and developers. This article attempts to close the gap by examining the financial profile of 153 properties developed for persons with serious mental illness by five nonprofit housing corporations between 1988 & 92.	This article attempts to close the gap by examining the financial profile of 153 properties developed for persons with serious mental illness by five nonprofit housing corporations between 1988 and 1992.	persons with serious mental illness who experience significant unmet housing needs	Our analysis suggests that although this housing may require more management attention, it is not fundamentally different from marketrate housing for low-income tenants. After more than 10 years, the nonprofit housing developers continue to thrive, and virtually all of the properties continue to serve persons with mental illness, demonstrating that such housing can be successfully developed and operated.	Homeless Mental Health	Mental Health	\$	The capital costs of housing for persons with mental illness and for market-rate housing do not differ substantially. Capital costs per unit (in 1995 dollars) ranged from a low of about \$20,000 to a high of almost \$66,000. Operating costs for housing for persons with mental illness are modestly higher than for market-rate housing, and their composition differs as well. Debt service per unit was comparable, but only because a larger proportion of properties in the RWJF–PCMI sample, relative to a national sample, had long-term debt. Excluding debt service, mean annual per unit operating costs in the RWJF–PCMI properties are \$2,858, remarkably close to estimates of operating costs derived from other sources. Average maintenance and repair costs for the RWJF–PCMI sample were about 7 percent higher than for POMS properties serving lowincome tenants.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Harkness, Newman, Galster, & Reschovsky, 2004)	Robert Wood Johnson Foundation Program on Chronic Mental Illness in four of nine demonstration cities between 1988 and 1993		To determine the effects of housing and neighborhood features on residential instability and the costs of mental health services for individuals with chronic mental illness (CMI).	Medicaid and service provider data on the mental health service utilization of 670 individuals with CMI between 1988 and 1993 were combined with primary data on housing attributes and costs, as well as census data on neighborhood characteristics. Participants were assigned on a first-come, first-served basis to housing units as they became available for occupancy after renovation by the housing providers.	Study participants were living in independent housing units developed under the Robert Wood Johnson Foundation Program on Chronic Mental Illness	Study participants living in newer and properly maintained buildings had lower mental health care costs and residential instability. Buildings with a richer set of amenity features, neighborhoods with no outward signs of physical deterioration, and neighborhoods with newer housing stock were also associated with reduced mental health care costs. Study participants were more residentially stable in buildings with fewer units and where a greater proportion of tenants were other individuals with CMI. Mental health care costs and residential instability tend to be reduced in neighborhoods with many nonresidential land uses and a higher proportion of renters. Mixed-race neighborhoods are associated with reduced probability of mental health hospitalization, but they also are associated with much higher hospitalization costs if hospitalized. The degree of income mixing in the neighborhood has no effect.	Homeless Mental Health	Mental Health	\$ of significant effects on Hospital Costs from baseline \$2051	Black = -59.9; Female = -64.1; % white in neighborhood = +103.5; Physical problems with building = +79.1; private hospital -70.8; Global Assessment of Functioning (GAF) scores = +173.9

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Hoch & Dewa, 2007)	Global	cost effectiveness analysis	The principal aim of this article is to share lessons learned by the authors while conducting economic evaluations, using clinical trial data, of mental health interventions. These lessons are quite general and have clear relevance for pharmacoeconomic studies.	we explore how net benefit regression can be used to enhance consideration of key issues when conducting an economic evaluation based on clinical trial data.	Mental health patients	<p>The first study we discuss found that cost-effectiveness results varied markedly based on the choice of both the patient outcome and the willingness to pay for more of that outcome. The importance of willingness to pay was also highlighted in the results from the second study. Even with a set willingness-to-pay value, most of the time the probability that the new treatment was cost effective was not 100%. In the third study, the cost effectiveness of the new treatment varied by patient characteristics. These observations have important implications for pharmacoeconomic studies.</p> <p>Namely, analysts must carefully consider choice of patient outcome, willingness to pay, patient heterogeneity and the statistical uncertainty inherent in the data. Net benefit regression is a useful technique for exploring these crucial issues when undertaking an economic evaluation using patient-level data on both costs and effects.</p>	Mental Health	Mental Health	\$ Willingness to Pay Lambda	<p>Overall costs in individuals receiving individual placement and support were 16% greater, on average, than overall costs in individuals receiving enhanced vocational rehabilitation (\$29,087 vs \$25,119 for 18 months [1995 values]). If one values the benefits of an hour of competitive employment at more than \$US13 (i.e. <math>\lambda &gt; \\$US13</math>), individual placement and support is cost effective. However, if one values an hour of competitive employment at less than \$US13 (i.e. <math>\lambda &lt; \\$US13</math>), the extra benefit of individual placement and support is not worth the extra cost.</p>

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Hueston, Quattlebaum, & Benich, 2008)	Medical University Hospital of the Medical University of South Carolina	from the perspective of Medicaid, the predominant payer for pregnancy-related	To determine the optimal time for teens to start prenatal care, this observation suggests that significant cost savings might be realized if teens were able to obtain prenatal care in a timely fashion.	Cost projections were based on current recommended prenatal care testing, the cost of vaginal and cesarean deliveries, and the estimated costs for care of the child in the first year of life. We then compared average cost per person and performed sensitivity analyses based on when prenatal care would have started.	Pregnanant teen	Compared with no prenatal care, any prenatal care saves between \$2,369 and \$3,242 per person, depending on when care is initiated. All savings are related to reductions in the cost of caring for low-birth weight babies. We found no cost advantage to starting prenatal care earlier compared with later months.	Pregnanant teen	Pregnanant teen who receives prenatal care	\$/mother child \$/preterm birth avoided	If prenatal care does reduce the rate of low-birth weight babies, prenatal care is cost beneficial. If a program was developed to improve access for teens and applied to all pregnant teens not in care by 6 months' gestation, the program would have to average \$95 or less per person to be cost beneficial if it reduced the number of low-birth weight deliveries by 50%.
(K. Jones, et al., 2003)	New York City	cost analysis	Cost-effective programs are needed to assist homeless persons with severe mental illness in their transition from shelters to community living. The authors investigated the cost-effectiveness of the critical time intervention program, a time-limited adaptation of intensive case management, which has been shown to significantly reduce recurrent homelessness among men with severe mental illness.	Ninety-six study participants recruited from a psychiatric program in a men's public shelter from 1991 to 1993 were randomly assigned to the critical time intervention program or to usual services. Costs and housing outcomes for the two groups were examined over 18 months.	homeless persons with severe mental illness	The critical time intervention group and the usual services group incurred mean costs of \$52,374 and \$51,649, respectively, for acute care services, outpatient services, housing and shelter services, criminal justice services, and transfer income.	H MH	MH	\$ Housing stability	The critical time intervention group experienced significantly fewer homeless nights than the usual care group (32 nights versus 90 nights). For each willingness-to-pay value—the additional price society is willing to spend for an additional nonhomeless night—greater than \$152, the critical time intervention group exhibited a significantly greater net housing stability benefit, indicating cost-effectiveness, compared with usual care.



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(C. Jones & Pawson, 2009)	United Kingdom		This article illustrates and evaluates the use of the cost-effectiveness concept in local housing policy. It addresses this task by examining its application to two contemporary housing policy innovations in England: choice-based lettings (CBL) and homelessness prevention.	The research assesses the costs and benefits to local public agencies of these policies through the use of the case-study method. It demonstrates that increased public expenditure to prevent homelessness or introduce CBL can be cost-effective.	Homeless	<p>This finding supports the 'Best Value' agenda but the article demonstrates that the simple principle can be difficult to apply. The article offers a major contribution to the application of costeffectiveness analysis within this context in elucidating the research processes and data required. We illustrate how the assessment of cost-effectiveness poses challenges in terms of both data availability and theoretical issues. Whereas the balance of costs and benefits may be clear, conclusions are often conditional or dependent on local circumstances. Major analytical constraints include the paucity of activity-based costing for social landlords, combined with the lack of a national protocol on cost accounting. Additionally, given that the measurement of potential benefits can be dependent on assumptions about long-term (market)outcomes there is a case for post-evaluation as well as pre-evaluation.</p>	Homeless	Housed	UKP	Total saving of 1344 and Net saving of 1007 UKP of driect housing (CBL) over homeless prevention programs.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Key, et al., 2008)	United States	included cih-2, survival, and cost– benefit analysis	To evaluate the effectiveness of a secondary teen pregnancy prevention intervention that includes school-based social work services coordinated with comprehensive health care for teen mothers and their children.	A prospective cohort study compared subsequent births to teen mothers followed for at least 24 months or until age 20 years (whichever was longer) compared with matched subjects from state data. Analyses were based on intent to treat.	Subjects included 63 girls (97% eligible, 99% African-American, mean age 16 years).	The majority of subjects used contraception (93%), with greater use of medroxyprogesterone associated with participation in coordinated medical care (80% vs. 50%). Subsequent births were more common in the comparison group (33%) than among subjects (17%) ( $p = .001$ ), and survival curves were significantly different ( $p = .007$ ) (hazard ratio = 2.5). There was a trend toward fewer births with increased participation in medical care ( $p = .08$ ) and case management ( $p = .08$ ) but not with group meetings.	sexually unaware teen	sexually aware teen	\$ saved/ birth avoided	Cost savings were calculated as \$19,097 per birth avoided or \$5,055 per month.
(Morris, Donkin, Wonderling, Wilkinson, & Dowler, 2000)	UK	Survey	What is the minimal money costs, together with those of a home and other basic necessities, indicate disposable income that is now essential for health	Prospective Cohort	Men 18-30	costs were assessed at BP131.86 per week (UK Apr 99 prices). Component costs, especially those of housing (which represents 40% of this total), depend on region and on several assumptions. By varying these a range of totals from BP106.47 to BP163.86 per week was detailed. These figures compare, 1999, with the new UK national minimum wage, after statutory deductions, of BP105.84 at 18-21 years and BP121.12 at 22+ years for a 38 hour working week. Corresponding basic social security rates are BP40.70-BP51.40 per week.	Unhealthy living	Gainfully employed	UKP/week	131.86 1999 UKP

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Rosenthal, et al., 2009)	Harlem, NY	Using data from 1997–2003, an in-time intervention analysis was conducted to determine program cost–benefit while teenagers were enrolled.	The study used a community-based participatory research approach to develop estimates of the cost–benefit of the Pathways/Senderos Center, a comprehensive neighborhood-based program to prevent unintended pregnancies and promote positive development for adolescents.	an extrapolation analysis was then used to estimate accrued economic benefits and cost–benefit up to age 30 years.	pregnant teens	The program operating costs totaled \$3,228,152.59 and reduced the teenage childbearing rate from 94.10 to 40.00 per 1000 teenage girls, averting \$52,297.84 in total societal costs, with an economic benefit to society from program participation of \$2,673,153.11. Therefore, total costs to society exceeded economic benefits by \$559,677.05, or \$1599.08 per adolescent per year. In an extrapolation analysis, benefits to society exceed costs by \$10,474.77 per adolescent per year by age 30 years on average, with social benefits outweighing total social costs by age 20.1 years.	At risk teen females	pregnancy prevented	\$	The program operating costs totaled \$3,228,152.59 and reduced the teenage childbearing rate from 94.10 to 40.00 per 1000 teenage girls, averting \$52,297.84 in total societal costs, with an economic benefit to society from program participation of \$2,673,153.11. Therefore, total costs to society exceeded economic benefits by \$559,677.05, or \$1599.08 per adolescent per year. In an extrapolation analysis, benefits to society exceed costs by \$10,474.77 per adolescent per year by age 30 years on average, with social benefits outweighing total social costs by age 20.1 years.
(Savhill, Thomas, & Monea, 2010)	United States	Review and Simulation	the authors discuss policies designed to motivate individuals to avoid unintended pregnancies, to improve their knowledge about contraception, and to remove barriers to contraceptive access.	Cost per participant for review and Cost Benefit Ratio for Simulation	pregnant teens	Preg Prev programs cost \$70-\$120 per person. The cost benefit ratio of a mass media campaign, Effective teen pregnancy prevention program, and Expanded access to subsidized contraception under Medicaid is \$3.60, \$2.07 and \$4.26 respectively.	At risk teen females	pregnancy prevented	\$ per person and CBR	Preg Prev programs cost \$70-\$120 per person. The cost benefit ratio of a mass media campaign, Effective teen pregnancy prevention program, and Expanded access to subsidized contraception under Medicaid is \$3.60, \$2.07 and \$4.26 respectively.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Shaw, 2000)	United States	N/A	Book Review	N/A	pregnant teen	Maynard in the final chapter estimates that the costs of teen pregnancy to U.S. taxpayers amount to almost \$7 billion annually. Extrapolating further, she estimates that the cost to society in lost national productivity and avoidable expenditure of social service resources is as much as \$30 billion annually.	pregnant teen	pregnant teen	\$/pregnant teens	Maynard in the final chapter estimates that the costs of teen pregnancy to U.S. taxpayers amount to almost \$7 billion annually. Extrapolating further, she estimates that the cost to society in lost national productivity and avoidable expenditure of social service resources is as much as \$30 billion annually.

## Evidence Table 3

**Table 0.3-League table of statistical sources**

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Amarasingham, Spalding, & Anderson, 2001)	Texas	medical record review with ICD codes	This study examines 93,074 diagnoses given to 20,331 homeless patients seen in a seven-year period in a primary care mobile and fixed clinic system.	retrospective cohort	urban homeless	The most frequent disease conditions evaluated in this cohort of patients are reported.	Homeless Users of healthcare services	treatment	diagnosis that leads to frequency of use	The three top diagnosis for the 12-19 are (Behavioral problems, Acute infection, Sexually transmitted disease.) For the older than 19 year old groups are (Drug and Alcohol abuse, Acute infection, and musculo skeletal problems).
(Bauer, Moughamian, Viloria, & Schneidermann, 2012)	Using administrative data from a San Francisco Medical Respite center (2007–2010)	(logistic regression, odds ratio).	Medical Respite addresses care needs of homeless patients post-hospital discharge and is linked to reduced rehospitalization compared with standard discharge. However, outcomes may differ for Respite patients who exit before completing post-acute treatment and discharge plans.	this retrospective study compares patient characteristics, post-Respite connections to community services, and likelihood of rehospitalization within 90 days of Respite exit between patients who choose to leave before discharge and all other Respite patients	Homeless visiting San Francisco Medical Respite center (2007–2010)	Patients who left early were more likely than others to decline referrals to services and more likely to be re-admitted within 90 days.	Homeless sick,	homeless treated	leaving early, recidivism	Of 860 encounters, 31% ended when patient chose to leave before discharge. Female gender (OR 1.65), living on the street immediately prior to Respite (OR 1.36) and substance use (OR 1.55) were associated with increased risk of leaving early.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Bender, Kapp, & Hahn, 2011)	Kansas	Retrospective Cohort	This study is based on analysis of secondary data that were collected in Community Mental Health Centers in Kansas purpose was to to examine whether youths' participation in case management is associated with increased utilization of individual and group mental health treatment, controlling for client satisfaction, severity of mental health symptoms, and demographic factors.	Linear regression	The sample of youth studied (N=293) ranged in age from 12 to 18 and received community mental health services. Youths' data come from combining 3 administrative data sources: (1)Medicaid billing data for children and youth receiving services from Kansas CMHCs, (2)Kansas Youth Satisfaction Survey data, and (3)Children's Status Report data.	participation in case management services predicts increased utilization of both individual and group mental health treatment. Case management may be a useful tool for retaining adolescent clients in mental health services.	youth with mental health problems	youth with mental health problems treated under case management	Beta	0.271 - 0.383

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Beutel, 2000)	United States -- sophomore cohorts of High School and Beyond, 1980, and the National Education Longitudinal Study of 1988	using longitudinal data	This study attempts to estimate and compare the effects of nonmarital childbearing on change in a social psychological variable, educational expectations, over the period between the sophomore year in high school and two years later.	multi level regression analysis	High school pregnant teen	Findings for both cohorts indicate that adolescent girls tend to reduce their educational expectations following a nonmarital pregnancy or birth. In addition, adolescent girls with low educational expectations are at greater risk of a nonmarital pregnancy or birth than adolescent girls with high educational expectation	pregnant teen in Highschool	Preganant teen	educational expectation	educational expectation [P(completing GED   pregnancy)] of unmarried mother: 1-13% of non-mother base probability of 87-98%; odds of unmarried motherhoodgetting pregnant are reduced by 19.5-27.8 percent [i.e., OR = ~.8] for each additional expected year of education
(Bouchard & Nguyen, 2010)	Quebec, Canada	logistic regression analyses	to assess whether criminal networks can help young offenders avoid contacts with the criminal justice system.	self-report delinquency survey	quasi-population of high-school students (N = 1,166)	“who you know” matters in the cultivation industry, and is an important independent predictor of arrest: very few young growers who were embedded in adult networks were apprehended.	young marijuana growers who were embedded in adult networks.	apprehended	number of adult connections	Beta = -1.61

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Bruns, Suter, & Leverentz-Brady, 2008)	United States	systematic review	this study established preliminary criteria for assessing the adequacy of wraparound implementation using the Wraparound Fidelity Index, version 3, a multiinformant interview that assesses conformance to wraparound principles.	The evaluation system was then applied to ten wraparound programs and 11 different study samples assessed via the Wraparound Fidelity Index version 3 in research studies. The system was constructed to discriminate different wraparound conditions assessed in research studies while still being attainable by the ten established wraparound programs.	children with behavioral health needs and their families	the mean overall Wraparound Fidelity Index (WFI) fidelity scores for the ten sites ranged from 72.2% to 80.1%, with a site-level mean of 76.7% (SD=2.3). Results of one-way ANOVA found significant differences across all sites [F(9, 656)=5.951; p<0.0001]	children with behavioral health needs and their families	children with behavioral health needs and their families with wraparound process	Wraparound Fidelity Index (WFI) fidelity scores	Ranging from 60-72% for no wraparound group and 75-87% for wraparound group.



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Buchholz, et al., 2010)	USA	Case Control	This secondary analysis evaluated the prevalence and stability of homelessness over one year among veterans entering substance abuse treatment and explored associations among housing status, treatment outcomes, and Veterans Affairs (VA) service utilization.	Participants in a trial of on-site primary care for veterans entering substance abuse treatment (N=622) were placed in four groups based on housing status: housed at baseline and final follow-up (41%), homeless at baseline and final follow-up (27%), housed at baseline but homeless at final follow-up (8%), and homeless at baseline but housed at final follow-up (24%). Groups were compared on treatment retention, changes in Addiction Severity Index (ASI) composite scores, and VA service utilization and costs.	Homeless Veterans	Treatment retention and changes in ASI alcohol composites did not differ between groups. Compared with scores in the consistently housed group, the ASI drug composites improved less over time in the consistently homeless group ( $p=.031$ ) and the ASI psychiatric composites improved less in the group housed at baseline and homeless at final follow-up ( $p=.019$ ). All homeless groups were more likely than the consistently housed group to have inpatient admissions and incurred higher total treatment costs. The consistently homeless group was more likely to use emergency care than the consistently housed group.	Addicted Homeless Veterans	Homeless Veterans	Addiction Severity Index (ASI) composite scores	Treatment retention and changes in ASI alcohol composites did not differ between groups. Compared with scores in the consistently housed group, the ASI drug composites improved less over time in the consistently homeless group ( $p=.031$ ) and the ASI psychiatric composites improved less in the group housed at baseline and homeless at final follow-up ( $p=.019$ ). All homeless groups were more likely than the consistently housed group to have inpatient admissions and incurred higher total treatment costs. The consistently homeless group was more likely to use emergency care than the consistently housed group. (Odds Ratios given)

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Burgard, Seefeldt, & Zehner, 2012)	Michigan	logistic regression	Using new data from the Michigan Recession and Recovery Study, a population-based sample of working-aged adults from Southeastern Michigan, U.S.A., in late 2009 early 2010, we studied the health needs of people in different housing instability experiences	retrospective cohort	people in different housing instability experiences	found that about 0.3 respondents recently experienced some type of housing instability. Many, but not all, types of instability were associated with health. Even after adjustment for sociodemographic characteristics and earlier health, individuals who had moved for cost reasons in the past three years were more likely than those with no housing instability to report a recent anxiety attack, while those who experienced homelessness in the past year had a higher likelihood of reporting fair/poor self-rated health and of meeting criteria for major or minor depression. However, frequent moves were not associated with poorer health, and doubling up and eviction were not associated with poorer health after adjustment for characteristics that sort people into different housing instability experiences	Homeless sick	homeless treated	OR	Renters behind on rental payments were more likely to meet criteria for depression, while mortgage-holders behind on their mortgage or in foreclosure had a higher likelihood of reporting fair/poor self-rated health or a recent anxiety attack. Among respondents who had ever owned a home, those who completed a foreclosure recently were more likely to report major or minor depression or an anxiety attack. Table 4 Major and minor depression has the strongest association with being homeless - up to OR = 6.14. Moving in with someone (doubling up) is protective against depression OR = 0.85

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Burke, Johnson, Bourgault, Borgia, & O'Toole, 2013)	Rhode Island	logistic regression	To understand who becomes homeless because of unemployment and what they need.	Four- year time- series study. Homeless characteristics, co- morbid conditions, and needs are correlated with unemployment rates.	Veterans presenting for an initial health care assessment at the Providence VA Medical Center's Homeless-Oriented Primary Care Clinic (HOPC).	<p>The unemployment rate averaged 6.7% during years 1–2 (N=198) and 11.8% during years 3–4 (N=202). Those presenting during high unemployment worked most recently in clerical positions (10.4% vs. 4.5%, <math>p = .02</math>) and reported unemployment (OR=2.0; 95% CI; 1.07, 3.76) and unaffordable housing (28.7% vs. 15.2%; <math>p &lt; .01</math>) causing homelessness.</p> <p>Those reporting unemployment were more likely to be local residents (OR=2.1; CI=1.01, 4.53), but less likely to have family support (OR=0.4; CI=0.19, 0.87). While comparable proportions reported mental health conditions and received care, more high unemployment individuals reported needing additional care (59.9% vs. 42.9%; <math>p &lt; .001</math>) and that this was necessary for leaving homelessness (58.9% vs. 44.1%; <math>p = .05</math>).</p>	Unemployed	Unemployed homeless	OR unemployment OR homeless	reported unemployment (OR=2.0; 95% CI; 1.07, 3.76) and unaffordable housing (28.7% vs. 15.2%; $p < .01$ ) causing homelessness

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Chandler, Meisel, Hu, McGowen, & Madison, 1996)	California	Case Control	In a three-year controlled study, two California integrated service agency demonstration programs that combined structural and program reforms were tested to see if they produced improved outcomes for a cross-section of clients with severe and persistent mental illness.	Clients at an urban site and a rural site were randomly assigned to an integrated service agency program or to a comparison group who received the usual services. Data On client outcomes were drawn from databases and client and family interviews.	Clients with severe persistent mental health issues at an urban site and a rural site	<p>clients served by the integrated service agencies had less hospital care, greater workforce participation, fewer group and institutional housing arrangements, less use of conservatorship, greater social support, more leisure activity, less family burden, and greater client and family satisfaction.</p> <p>Clients in the urban demonstration program, but not those in the rural program, did better than the comparison group on measures of financial stability personal well-being, and friendship. At the urban site, 72.6 percent of clients participated in the work force during the three-year study period, compared with 14.6 percent of the clients in the comparison group. No differences were found at either site in rates of arrest and conviction and in self-reported ratings of self-esteem, symptoms, medication compliance, homelessness, and criminal victimization. The capitated costs for demonstration clients were much higher than the costs for Services used by comparison clients.</p>	Mental Health	Mental Health with integrated care	Participation in Workforce	At the urban site, 72.6 percent of clients participated in the work force during the three-year study period, compared with 14.6 percent of the clients in the comparison group

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Chantarat & Barrett, 2012)	simulation	econometric	the role social network capital might play in facilitating poor agents' escape from poverty traps	simulation	poor households	social network capital can either complement or substitute for productive assets in facilitating some poor households' escape from poverty. However, the voluntary nature of costly link formation also creates exclusionary mechanisms that impede some poor households' use of social network capital. Through numerical simulation, we show that the ameliorative potential of social networks therefore depends fundamentally on the broader socio-economic wealth distribution in the economy, which determines the feasibility of social interactions and the net intertemporal benefits resulting from endogenous network formation	Poor household no social connection	Poor household with social connection	various	probabilities given

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Chuang & Wells, 2010)	United States	Retrospective Cohort	This study examined associations for three dimensions of collaboration between local child welfare and juvenile justice agencies jurisdiction, shared information systems, and overall connectivity and youths' odds of receiving behavioral health services.	Data were drawn from the National Survey of Child and Adolescent Well-Being, a national survey of families engaged with the child welfare system.	youth receiving behavioral health services	<p>Having a single agency accountable for youth care increased youth odds of receiving outpatient and inpatient behavioral health services. Inter-agency sharing of administrative data increased youth odds of inpatient behavioral health service receipt.</p> <p>Clarifying agency accountability and linking databases across sectors may improve service access for youth involved with both the child welfare and juvenile justice systems.</p>	youth receiving behavioral health services	youth receiving behavioral health services with coordination	OR of receiving substance abuse treatment given the availability of data sharing information systems	inpatient OR = 1.57; outpatient OR = 1.44

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Clark & Rich, 2003)	Suncoast Center for Community Mental Health, a large community mental health center also in Pinellas County, Florida	Case Control	The effectiveness of two types of service programs in ameliorating homelessness among individuals with severe mental illness was compared.	Homeless persons with severe mental illness were recruited into the study on their entry into one of two types of homeless service programs. In a quasi-experimental or nonrandom-assignment design, participants responded to instruments measuring housing status, mental health symptoms, substance use, physical health, and quality of life at baseline (program entry) and at six months and 12 months after entry.	Participants. High-, medium-, and low-impairment subgroups, based on psychiatric symptoms and degree of alcohol and illegal drug use, were formed by means of a propensity score subclassification. The first was a comprehensive housing program, in which consumers received guaranteed access to housing, housing support services, and case management. The second was a program of case management only, in which consumers received specialized case management services.	Persons with high psychiatric symptom severity and high substance use achieved better housing outcomes with the comprehensive housing program than with case management alone. However, persons with low and medium symptom severity and low levels of alcohol and drug use did just as well with case management alone.	Mental Health	Mental Health with integrated care or housing	each participant had a propensity score assigned, which was derived from baseline levels of mental health symptoms, days of alcohol use, and days of illegal drug use, or “level of psychiatric and substance abuse impairment.”	High-impairment participants showed less gain in stable housing and less reduction in functional homelessness in the program providing case management only than did high-impairment participants in the comprehensive housing program (propensity scores given)

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Conroy, 2001)	Los Angeles, CA	econometric probit	changes in welfare payments on the earnings behavior of homeless persons	cross sectional survey	1489 Homeless persons in LA	reducing government benefit income by \$100 increases probability of receiving income from traditional and non traditional sources by 1.37% and 2.18% respectively.	Homeless welfare recipient	Homeless non welfare recipient	change in traditional and non traditional income sources	by 1.37% and 2.18% respectively.
(R. L. Cooper, et al., 2010)	Nashville, Tennessee	The primary analyses used in this study were repeated measures ANOVA and the Friedman's two-way analysis test.	The objective of this research was to evaluate the impact of Integrated Assertive Community Treatment (I-ACT) on psychiatric symptoms, drug use, housing status, and service utilization.	A single-group repeated measures evaluation of outcome indicators at intake, 6 months, and 12 months examined changes over time with 555 respondents receiving outpatient treatment. While 555 received baseline interviews, figures vary on follow-up sample sizes and are listed as they are discussed in the paper. The study was implemented by a community treatment provider.	555 respondents receiving outpatient treatment on psychiatric symptoms, drug use, housing status, and service utilization	Significant reductions in substance use ( $F(1.69, 553.02) = 94.30, p < .01$ ) and psychiatric symptoms ( $F(1.98, 299.19) = 43.73, p = .0001$ ) were found from baseline to 6 months. Similar results were found in housing status with the number of participants in stable housing. Utilization of substance use and psychiatric treatment declined, and physical health service use remained unchanged. I-ACT is effective in community service provision settings in reducing substance use and psychiatric symptoms. Further, the reduction in service use found across follow-up points indicates cost containment.	Mental Health	Mental Health with integrated care or housing	Amount of substance use and psychotic symptoms	Significant reductions in substance use ( $F(1.69, 553.02) = 94.30, p < .01$ ) and psychiatric symptoms ( $F(1.98, 299.19) = 43.73, p = .0001$ ) were found from baseline to 6 months and changes were sustained from the 6- to 12-month follow-up points.



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Dauber, Neighbors, Dasaro, Riordan, & Morgenstern, 2012)	United States	Retrospective Cohort	This study examined the impact of intensive case management (ICM) on decreasing child welfare system involvement in a sample of substance-dependent parenting women who participated in a welfare demonstration study comparing ICM to usual screen-and-refer models employed in welfare settings. The current study tested whether ICM had downstream impacts on child welfare outcomes not directly targeted by the intervention.	The outcome data for this study have a two-level nested structure: children are nested within families (i.e., there are multiple children per caregiver), and there are repeated measures over time per child. In order to account for the dependence of observations produced by the nested data structure, we used multilevel mixed-effects logistic regression models to examine condition differences in yearly incident reports and child placements, controlling for covariates.	The sample included 302 mothers recruited from welfare offices and their 888 minor children. Child welfare outcomes were available from administrative records for 4 years following study entry and included incident reports and out-of-home child placements.	An initial positive effect of ICM was found on child placements, but its impact lessened over time and was likely due to the increased contact with casemanagers that occurred early in the study. Overall, minimal benefits of ICM were found, suggesting that while ICM was effective in the areas of treatment engagement and abstinence, there were no downstream benefits for child welfare outcomes. Implications of findings in terms of increased need for cross-system collaboration are discussed.	children with behavioral health needs and their families	children with behavioral health needs and their families involved with DYFS integrated care	Rates of (bad) incident reports; Prior DYFS involvement as a strong predictor of incident reports	Rates of (bad) incident reports over time = OR=.82; Prior DYFS involvement was a strong predictor of both incident reports OR=5.3 and child placement OR=15.7

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Dennis, Lassiter, Connelly, & Lupfer, 2011)	United States	retrospective cohort	Approval rates for first-time applications for Supplemental Security Income (SSI) and Social Security Disability Insurance (SSDI) among adults who are homeless can be as low as 10%. This study examined approval rates among applicants who were assisted by SSI/SSDI Outreach, Access, and Recovery (SOAR), a federal initiative to increase access to disability benefits among people who are homeless or at risk of homelessness and who have mental illness or other co-occurring disorders.	Data were collected in 37 states that had participated in SOAR for at least one year.	Supplemental Security Income (SSI) and Social Security Disability Insurance (SSDI) applicant adults who are homeless	Of 8,978 applications assisted by SOAR, 6,558 (73%) were approved. The average number of days between application and decision was 91. SOAR was associated with increased access to housing and cost savings through increased Medicaid reimbursement.	Homeless	Homeless receiving SSI or SSDI	SSI allowance rate	37 states reported assisting 8,978 persons with SSI and SSDI applications. Of those, 6,558 initial applications were approved, for an allowance rate of 73%. The average time to approval was 91 days, but there was wide variation among the states.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Doran, Ragins, Iacomacci, et al., 2013)	mid-sized northeastern US city		The aim of the study was to determine 30-day hospital readmission rates among patients who are homeless and examine factors associated with hospital readmissions in this population.	We conducted a retrospective chart review of patients who were homeless and hospitalized at a single urban hospital from May–August 2012. Homelessness was identified by an electronic medical record flag and confirmed by manual chart review. The primary outcome was all-cause hospital readmission to the study hospital within 30 days of hospital discharge. Patient-level and hospitalization-level factors associated with risk for readmission were examined using generalized estimating equations.	patients who were homeless and hospitalized	There were 113 unique patients who were homeless and admitted to the hospital a total of 266 times during the study period. The mean age was 49 years, 27.4% of patients were women, and 75.2% had Medicaid. Half (50.8%) of all hospitalizations resulted in a 30-day hospital inpatient readmission and 70.3% resulted in either an inpatient readmission, observation status stay, or emergency department visit within 30 days of hospital discharge. Most readmissions occurred early after hospital discharge (53.9% within 1 week, 74.8% within 2 weeks). Discharge to the streets or shelter versus other living situations was associated with increased risk for readmission in multivariable analyses.	homeless patient	homeless	Readmission risk	Medicaid insurance (vs. other) OR = 1.99; History of substance abuse OR = 1.41; Discharge to Friends, family, hotel, motel Adjusted OR = 0.42, Rehabilitation facility, skilled nursing facility, or psychiatric hospital Adjusted OR = 0.25 vs discharge to street.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Fletcher & Wolfe, 2009)	United States - The data we use in our analysis are from the restricted version of the National Longitudinal Study of Adolescent Health (Add Health).	Regression analysis	The question of whether giving birth as a teenager has negative economic consequences for the mother remains controversial despite substantial research. In this paper, we build upon existing literature, especially the literature that the experience of teenagers who had a miscarriage as the appropriate comparison group.	Retrospective cohort	US teen mothers	We show that miscarriages are not random events, but rather are likely correlated with (unobserved) community-level factors, casting some doubt on previous findings. Including community-level fixed effects in our specifications lead to important changes in our estimates. By making use of information on the timing of miscarriages as well as birth control choices preceding the teenage pregnancies we construct more relevant control groups for teenage mothers. We find evidence that teenage childbearing likely reduces the probability of receiving a high school diploma by 5 to 10 percentage points, reduces annual income as a young adult by \$1,000 to \$2,400. and may increase the probability of receiving cash assistance and decrease years of schooling.	At risk teen females	pregnant teen	education attainment and employment \$ as a result of teen pregnancy	We find evidence that teenage childbearing likely reduces the probability of receiving a high school diploma by 5 to 10 percentage points, reduces annual income as a young adult by \$1,000 to \$2,400. and may increase the probability of receiving cash assistance and decrease years of schooling

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Fletcher, 2011)	A national sample of US teenagers combined with a complementary sample of US adults	linear regression	to examine the effects of teenage childbearing on health behaviors by comparing female siblings in both the teenage sample and a sample of adults.	Retrospective cohort	A national sample of US teenagers	teenage childbearing has negligible effects on several measures of unhealthy behaviors for mothers and may be protective for drug use and binge drinking.	pregnant teen	pregnant teen with health behaviors	percent change in behavior as a result of child bearing	In the case of tobacco use, the estimate suggests a 6 percentage point increase from a live birth; The baseline results suggest a 13.5 percentage point reduction in binge drinking for women who gave birth as a teen; The baseline estimates suggest a 10 percentage point reduction in Marijuana use for women who give birth as a teenager. women who had live births with those who had late miscarriages produces a 7 percentage point reduction in marijuana use
(Gilmer, et al., 2004)	San Diego County, CA	logistic regression	The authors' goal was to evaluate the relationship between adherence to treatment with antipsychotic medication and health expenditures. A secondary objective was to identify risk factors predictive of nonadherence.	Data included Medicaid eligibility and claims data from 1998 nonadherence, partial adherence, and excess were used to assess adherence to treatment.	Medicaid beneficiaries with schizophrenia	Total costs for excess fillers (\$14,044) were substantially higher than total costs for any other group.	mental patient	hospitalized	adherence to treatment	Forty-one percent of Medicaid beneficiaries with schizophrenia were found to be adherent to treatment with their antipsychotic medications: 24% were nonadherent, 16% were partially adherent, and 19% were excess fillers. Rates of psychiatric hospitalization were lower for those who were adherent (14%) than for those who were nonadherent (35%), partially adherent (24%), or had excess fills (25%). Rates of medical hospitalization were lower for those who were adherent (7%) than for those who were nonadherent (13%) or had excess fills (12%).

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Giordano & Lindstrom, 2011)	United Kingdom	Logistical Regression analysis	the association between changes in psychological health over time and three different individual-level proxies of social capital, measures of socio-economic status, social support and the confounders age and gender. All data are derived from the British Household Panel Survey data, with the same individuals (N = 7994) providing responses from 2000-2007.	Retrospective Cohort	UK Residents	found that generalised trust was the only social capital variable to maintain a positive and highly significant association with psychological health in multivariable models. All measures of socioeconomic status and social support were rendered insignificant, bar one. the breakdown of the traditional family unit (and subsequent reduction in family capital investment), along with psychosocial pathways, demonstrate plausible mechanisms by which a decrease in generalised trust could lead to an increasing trend of worse psychological health in youth over successive birth cohorts. Policy makers, while providing welfare solutions in response to breakdown in traditional family structure, must also consider perverse incentives they provide. If perceived as a viable lifestyle choice, welfare provision could inadvertently promote further decline of trust, at even greater cost to society.	Good or poor mental health	Good or poor mental health	generalised trust was the only social capital variable to maintain a positive and highly significant association with psychological health	OR = 1.3 - 1.35

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Ku, Scott, Kertesz, & Pitts, 2010)	USA		Homeless individuals frequently use emergency departments (EDs), but previous studies have investigated local rather than national ED utilization rates. This study sought to characterize homeless people who visited urban EDs across the U.S.	We analyzed the ED subset of the National Hospital Ambulatory Medical Care Survey (NHAMCS-ED), a nationally representative probability survey of ED visits, using methods appropriate for complex survey samples to compare demographic and clinical characteristics of visits by homeless vs. non-homeless people for survey years 2005 and 2006.	homeless people who visited urban EDs across the U.S.	homeless ED visitors were more likely to have arrived by ambulance, to be seen by a resident or intern, and to be diagnosed with either a psychiatric or substance abuse problem. Compared with others, ED visits by homeless people were four times more likely to occur within three days of a prior ED evaluation, and more than twice as likely to occur within a week of hospitalization. Conclusions. Homeless people who seek care in urban EDs come by ambulance, lack medical insurance, and have psychiatric and substance abuse diagnoses more often than non-homeless people. The high incidence of repeat ED visits and frequent hospital use identifies a pressing need for policy remedies.	H MH	MH	frequency of use and recidivism	Homeless individuals from all age groups made 550,000 ED visits annually (95% confidence interval [CI] 419,000, 682,000), or 72 visits per 100 homeless people in the U.S. per year. Homeless people were older than others who used EDs (mean age of homeless people = 44 years compared with 36 years for others). ED visits by homeless people were independently associated with male gender, Medicaid coverage and lack of insurance, and Western geographic region.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Kuehn, 2012)	USA	editorial cost effectiveness	To discuss Efficacy of harm reduction and programs	editorial cost effectiveness	chronically ill, homeless people	<p>A study of more than 10 000 homeless individuals in Los Angeles County found that those placed in supportive housing (1000 of the total) cost the public \$605 each per month, compared with \$2897 each for similar individuals who were not in such a program, according to a 2011 report from the USICH. Supportive housing also appears to reduce the burden on the health care system. Researchers randomized 400 chronically homeless individuals treated at 2 Chicago hospitals between September 2003 and May 2006 to either supported housing or usual care.</p>	Housing and Mental Health	Only Mental Health	frequency of use and recidivism	<p>After 18 months, they found that compared with the controls, the individuals living in supported housing had 29% fewer hospitalizations, 29% fewer days hospitalized, and one-quarter fewer emergency department visits. A statewide analysis of supported housing found that supported housing virtually eliminated temporary housing and incarceration costs for participating individuals. It also reduced ambulance costs by a third and emergency department costs by 14%, according to the USICH report. Cost reductions were also seen among the subset of chronically homeless individuals with severe alcohol use problems. Researchers compared the costs associated with 95 individuals with severe alcohol use disorders. In the year before they entered supportive housing, individuals in the intervention group were responsible for \$8,175,992 in public costs, or an average of \$4066 per person each month. After 6 months in supportive housing, the individual permonth cost decreased to \$1492, and by 12 months it was below \$1000 per month. a savings of \$2449 per person month in the program is calculated.</p>



Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Levine & Painter, 2003)	This study uses the National Educational Longitudinal Survey of 1988	logistic regression	to examine the extent to which the apparent effects of out-of-wedlock teen childbearing are due to preexisting disadvantages of the young women and their families.	We use a novel method that matches teen mothers to similar young women in their junior highschool (that is, prior to pregnancy).	pregnant teens	Teen out-of-wedlock mothers had a dropout rate of 44%, 5 times the rate of other young women (9%). Among high school graduates, the young mothers' rate of entering college by age 20 was less than half that of their peers (3% versus 76%). teen mothers-to-be were twice as likely to be living with a single mother( 27% versus14%), both of their parents education was 0.4 standard deviation lower than their peers' parents', and their parents reported somewhat lower parent involvement.	At risk teen females	pregnant teen	Rate of GED	Teen out-of-wedlock mothers The families' income needs ratios were only a third of the average and they had changed schools twice as frequently as other young women (41% versus 21%). By eighth grade, they had half a standard deviation lower test scores than did young women who would not become teenage unwed mothers. They were also twice as likely to smoke(11% versus 5%). parents and teachers were more than twice as likely to report behavior problems (18% versus7%), and their rate of severe emotional problems although low, was more than triple that of their peers (5.1% versus1.8%). The teen mothers-to-be were also much more likely to come to school unprepared or cut class. In addition they were also more likely to have been held back in school (29% versus 11%).

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Loveland & Boyle, 2007)	Many	counted frequencies	<p>This article reviews the research on intensive case management (ICM) programs as a jail diversion intervention for people with a serious mental illness (SMI). The review includes two types of ICM programs: (a) general ICM programs that included an assessment of arrests and incarceration rates for people with an SMI and (b) ICM programs specifically implemented as a component of a jail diversion intervention for people with an SMI. .</p>	Systematic Review	people with a serious mental illness (SMI)	Results indicate that general ICM programs rarely led to reductions in jail or arrest rates over time, and these rates were similar to those found in standard mental health services.	mental patients	incarcerated mental patients	<p>a 3-point scoring system for each outcome that includes + if the experimental ICM program affected the outcome in the expected or hypothesized direction 0 if no difference was found between conditions for experimentally designed studies or no change was observed over time in PPD studies, and – if rates of criminal justice involvement were higher (opposite the expected direction) in the experimental condition compared to the control group or if rates of criminal justice involvement increased over time in PPD studies.</p>	<p>General ICM programs that included an integrated addiction treatment component (8) had mixed results but a trend toward reductions in rates of arrests and incarceration over time for individuals with an SMI and a co-occurring substance use disorder. Results were mixed for jail diversion interventions with an ICM program, but most ICM programs (8) led to significant reductions in arrests and incarcerations over time.</p>

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Matthews, Krivelyova, Stephens, & Bilchik, 2013)	Alabama	retrospective cohort	This study examines the effectiveness of a system-of-care-grant-funded community in Birmingham, AL compared to a matched comparison community in Montgomery, AL in reducing youth contact with the juvenile justice system.	Logistic regression	Youth with serious emotional disturbance involved in juvenile justice systems	results demonstrate greater reductions in the likelihood of juvenile justice involvement among youth served in systems of care over time compared to those served in a services-as-usual environment. These findings show the benefits of the incorporation of system-of-care principles for youth with a multitude of needs.	Youth with serious emotional disturbance involved in juvenile justice systems	Youth with serious emotional disturbance involved in juvenile justice systems receiving community care	Contact with justice system	OR=18.671
(Melberg, et al., 2011)	four Nordic capitals: Copenhagen, Helsinki, Oslo and Stockholm	Survey	explores different approaches to quantify the human costs related to drug use	Prospective Cohort	The data come from a representative survey of 3092 respondents above the age of 18	The results show that in most Nordic capitals more than half of the respondents at some time have known and worried about the drug use of somebody they know personally.	Addicted	Treatment	Qualitative Scale 1-10. Also WTP for treatment in Euros	while the average reported harm was about 2 on a scale from 0 to 10, a significant minority (10%) of those knowing drug users indicated that the harm was above 5. WTP = E500-E13000
(Ochsen & Welsch, 2011)	10 European countries	Linear Regression	the linkage between personal life satisfaction and a macroeconomic indicator of the duration of unemployment.	Retrospective Cohort N= 50,000	The data on life satisfaction and sociodemographic characteristics are taken from the Eurobarometer survey series.	social costs of unemployment, namely impact on life satisfaction, relate to a considerable extent to unemployment duration. It is not just the risk of becoming or staying unemployed that people worry about, but especially the prospect of staying long-term unemployed. This fear affects employed and unemployed people alike.	unemployed happy	unemployed unhappy	Life satisfaction	Beta =0.0427

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Ou & Reynolds, 2013)	Chicago, IL	Probit regression	The present study investigated the relationships between the timing of women's first childbirth and their postsecondary education using an innercity minority cohort.	Retrospective cohort	The study sample (695 females) was drawn from the Chicago Longitudinal Study (CLS), an ongoing investigation of a panel of low-income minority children (94% African American) born in 1980 who grew up in high-poverty neighborhoods in Chicago.	The findings indicated that, taking into account sociodemographic factors and early academic achievement, first childbirths before age 18 and between ages 19 and 21 were significantly associated with lower rates of college attendance and bachelor (BA) degree completion. First childbirths between ages 21 and 25 were not significantly associated with any outcome of postsecondary education.	pregnant teen	pregnant teen with education	Probability of attending college according to age of first birth	Except first childbirths between ages 21 and 25, all ages of first childbirths were significantly associated with lower rates of college attendance and 4-year college attendance. Among the significant ages of first childbirths, first childbirths before age 18 had larger negative associations with college attendance than first childbirths at later ages. For example, for college attendance, the marginal effects of first childbirths before age 16 and between ages 16 and 18 were $-.37$ and $-.28$ , respectively ( $p < .01$ ). And the marginal effects of first childbirths at age 18 and between age 19 and 21 were $-.27$ and $-.19$ , respectively ( $p < .01$ ).

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(StevensSimon, Dolgan, Kelly, & Singer, 1997)	Denver, Colo.	Two-year, prospective, randomized controlled trial.	To test the hypotheses that (1) a monetary incentive promotes peer-support group participation; and (2) peer-support group participation decreases repeat adolescent pregnancies.	Participants were randomized to 4 interventions: monetary incentive and peer-support group, peer-support group only, monetary incentive only, or no intervention.	A total of 286 primiparous girls younger than 18 years, whose infants were younger than 5 months.	Participation in interventions was generally low. Hypothesis 1 was supported: 58% of those offered a monetary incentive participated in the peer-support groups, compared with 9% of those who were not offered the incentive. Hypothesis 2 was rejected: the peer-support group experience failed to prevent repeat pregnancies. The incidence of second pregnancies at 6 months (9%, 22/248), at 12 months (20%, 49/248), at 18 months (29%, 72/248), and at 24 months (39%, 97/248) following delivery did not vary significantly in relation to intervention strategy. Background sociodemographic characteristics significantly affected the timing of subsequent conceptions but not intervention participation.	pregnant teen	pregnant teen	Consistency of participation in planned intervention and repeat pregnancy.	Participation in interventions was generally low. Hypothesis 1 was supported: 58% of those offered a monetary incentive participated in the peer-support groups, compared with 9% of those who were not offered the incentive. Hypothesis 2 was rejected: the peer-support group experience failed to prevent repeat pregnancies. The incidence of second pregnancies at 6 months (9%, 22/248), at 12 months (20%, 49/248), at 18 months (29%, 72/248), and at 24 months (39%, 97/248) following delivery did not vary significantly in relation to intervention strategy.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Webbink, Martin, & Visscher, 2011)	Australia	Cross sectional t-tests	This paper estimates the causal effect of teenage childbearing on educational attainment using two cohorts of Australian twins and their relatives.	Retrospective cohort	Australian teen mothers	Our main finding is that the negative effect of teenage childbearing on educational attainment appears to be small. We find no difference in educational attainment between teen mothers and their identical twin sisters. Data on the relatives of the twins enable us to compare a teen mother with both her twin sister and her other sibling sisters. When twin sisters are used as a control group instead of sibling sisters, the estimated difference in educational attainment is much smaller.	pregnant teen	pregnant teen with education	education attainment as a result of teen pregnancy	Our main finding is that the negative effect of teenage childbearing on educational attainment appears to be small. We find no difference in educational attainment between teen mothers and their identical twin sisters. Data on the relatives of the twins enable us to compare a teen mother with both her twin sister and her other sibling sisters. When twin sisters are used as a control group instead of sibling sisters, the estimated difference in educational attainment is much smaller.

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Wilson & Hoge, 2013)	Ottawa, Canada	prospective cohort	This study evaluated the Ottawa Community Youth Diversion Program (OCYDP), a diversion program structured according to the risk, need, responsivity principles of offender rehabilitation.	In order to explore whether there were any differences between samples, chi-square and independent t-tests were first conducted.	targeting medium-risk youth. Due to the categorical nature of the dependent variable (reconvicted vs. not reconvicted), survival analysis was used to examine the degree to which disposition type (i.e., diversion vs. probation) and program completion level (i.e., successful, partial, noncompletion vs. probation) predicted time to reconviction for the four follow-up time frames.	<p>The recidivism rate of 170 postcharge youth referred to the OCYDP were compared to that of 208 matched youth sentenced to a period of probation. Youth referred to diversion had significantly lower reoffense rates than those referred to probation even when controlling for risk level, age, gender, and nature of the index offense.</p> <p>However, program completion within the diversion program impacted outcomes, with those failing to complete the program showing higher recidivism levels than the probation youth.</p>	post charge youth	postcharge youth referred to the OCYDP	recidivism difference	Odds Ratios: most sensitive to disposition and gender

Author (Date)	Location	Model type	Authors purpose	Method	Target Pop	Results	Begin State	End State	Units	How many units
(Wright, Russell, Anderson, Kooreman, & Wright, 2006)	Indianapolis, Indiana	Retrospective Cohort	This study draws on team membership and attendance data to identify and describe the structure of service coordination teams in the Dawn Project, a system-of-care initiative. This analysis examines three dimensions of team structure—size, form, and role composition—as well as the effect of these dimensions on the young people's program disposition..	Network cluster analysis	youth in a system of care	The results suggest that service coordination teams are most likely to be effective in achieving the team's treatment goals when they consist of four to eight members and include the youth and multiple family members. More generally, the findings underline the importance of considering team structure as an important force in shaping the effectiveness of service coordination programs and the potential utility of social network methods for studying these effects.	youth in a system of care	youth in a system of care with team support	OR success if member present	Father = 2.26 Educator = 2.38



## Curriculum Vitae

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### EDUCATION

**Johns Hopkins University, Bloomberg School of Public Health,  
Department of Health Policy and Management, Baltimore, MD.**

- Doctor of Public Health (DrPH) in Health Policy and Leadership,  
Dissertation title: “A Cost-effectiveness approach to calculating SROI for integrated and interoperable health and social services in a local health and human services department.”  
Advised by: Harold P. Lehmann, MD. PhD. Defended February 2015

- Certificate in Public Health Informatics, 2013

**University of Florida, Gainesville, FL.**

Pre-Doctoral Fellow, Health Services Research, and Public Health August 2001-August 2006

- Master of Public Health (MPH), December 2006
- Master of Health Administration (MHA), August 2001
- Master of Business Administration (MBA), August 2001

**University of Pittsburgh, Pittsburgh, PA.**

- Bachelor of Science (BS), May 1999

Major in Neuroscience, Minor in Chemistry

## **EXPERIENCE**

**Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD.**

**Research Assistant, March 2009-2015**

- **Dissertation project:** The Social Return on Investment (SROI) model and calculator of the Interoperability project for Montgomery County Department of Health and Human Services utilizes systematic literature reviews, interviews, persona development, influence diagrams, decision trees, and other qualitative and quantitative data analysis techniques.

**Advisor: Professor Harold Lehmann (2013-2015)**

Funded by the Administration of Children and Families-US Department of Health and Human Services through Montgomery County Department of Health and Human Services

- Interoperability of Human Services: Professor Laura Morlock (2010-12) funded by the Administration of Children and Families- US Department of Health and Human Services
- Tobacco Economics in Mexico: Professor Hugh Waters (2009-10) funded by the Bloomberg Philanthropies as part of the Bloomberg Initiative to Reduce Tobacco Use.
- Systematic Review of Hazards During Cardiac Surgery: Professors Elizabeth Martinez and Peter Pronovost (2008-09) funded by the Johns Hopkins University Quality and Safety Research group

**Teaching Assistant, March 2009-2012**

**For each of the following classes managed class activities for a group of 25 students. Activities included organizing class sessions, occasional class lectures, consistent correspondence with students addressing students questions and concerns, one on one mentoring, editing and grading of student exams and papers, and final grade delivery.**

- 309.616.81-Introduction to Methods for Health Services Research and Evaluation (Professor Johnathan Wiener et al 2010-11-12)
- 313.790.81-Economic Evaluation I (Professor Kevin Frick 2011)
- 309.670.01-Comparative Health Insurance (Professor Hugh Waters 2009-10 & Professor Gerard Andersen 2011)

- 221.722.81-Quality Assurance Management Methods for Developing Countries  
(Professor Gilbert Burnham et al 2010)
- 221.661.01-Project Development for Primary Health Care in Developing Countries  
(Professor Gilbert Burnham et al 2009)

**Abt Associates, Bethesda, MD.**

**Consultant, Health Systems 20/20 Project;**

**July 2010-November 2010**

- Organized, and consolidated data from various National Health Accounts (NHA) studies
- Prepared data in standard format for presentation on the NHA site of the World Health Organization (WHO)

**World Health Organization - Pan American Health Organization (PAHO),  
Washington D.C.**

**Consultant, Division of Quality of Care and Patient Safety;**

**August 2006-December 2007**

- Organized the First Regional Workshop on Clean Care is Safer Care (San Jose, Costa Rica March 2007)
- Participated in protocol development of an epidemiological study of the medical errors in Latin America (IBEAS).
- Participated in the drafting of the resolution on Quality of Care and Patient Safety in the Americas presented to the 27<sup>th</sup> Pan American Sanitary Conference and resolution passed through member states vote. (Oct. 2007)

## PUBLICATIONS

### Peer Reviewed Reports

- Martinez EA, Thompson DA, Errett NA, Kim GR, Bauer L, Lubomski LH, Gurses AP, Marsteller JA, **Mohit B**, Goeschel CA, Pronovost PJ. *Review article: high stakes and high risk: a focused qualitative review of hazards during cardiac surgery*. Anesth Analg. 2011 May;112(5):1061-74.
- Waters H., Sáenz de Miera B., **Mohit B.**, Ross H., Reynales Shigematsu L.M.; “*Tobacco Economics in Mexico*” One of a series of reports on tobacco taxation-a key component of the MPOWER package-funded by the Bloomberg Philanthropies as part of the Bloomberg Initiative to Reduce Tobacco Use; October 2009
- **Mohit B.**; “*A literature review of the situation of quality of healthcare services and patient safety in Latin America, and the Caribbean region*” as cited in Espiritua N, Lavadob G, Pantojac L, Lamd C, Barrientosd M, Centenoe R. *Notificación de eventos adversos en un hospital nacional en Lima* (Notification of adverse events in a the National Hospital in Lima.) Rev Calidad Asistencial. 2007;22(6):335-41 (Spanish)

### Conference Papers

- Morlock L., Richeson K., Baller J., Okebukola P., and **Mohit B.** “*National Human Services Interoperability Architecture Performance Reference Model*.” Presented June 2013 by Morlock L. at the 8th Annual Stewards of Change Symposium in Baltimore, MD. Available at: [https://www.acf.hhs.gov/sites/default/files/assets/c\\_03\\_nhsiaperformancereferencemodel\\_d02.pdf](https://www.acf.hhs.gov/sites/default/files/assets/c_03_nhsiaperformancereferencemodel_d02.pdf)
- Montenegro H, Gonseth J, and **Mohit B.** “*Resolution on Quality of Care and Patient Safety in the Americas*” Presented Oct. 2007 by Montenegro H. at the 27<sup>th</sup> Pan American Sanitary Conference and resolution passed through member states vote in Washington, DC. Available at: <http://www1.paho.org/english/gov/csp/csp27-16-e.pdf?ua=1>
- **Mohit B.** “*Iran; A revolutionary PHC system in evolution. Summer 2001 residency report*” Presented December, 2005 as a poster by Mohit B. at the 133<sup>rd</sup> meeting of the American Public Health Association in Philadelphia, PA.
- **Mohit B.** “*Healthcare in Iran-Past, present, and trends of the future.*” Presented October, 2004 by Mohit B. at Iran, Future Prospects; at the Hoover Institute, Stanford University in

Palo Alto, CA. Available at: [http://web.stanford.edu/group/psa/events/2004-05/ifp\\_04/presentations.html](http://web.stanford.edu/group/psa/events/2004-05/ifp_04/presentations.html)

- Frank R.G., **Mohit B.** “*Considering the Impact of Chronic Conditions on the HealthCare Systems in Iran and the United States.*” Presented December 2003 jointly with Frank R.G at the Epidemiology of Substance Abuse and Mental Health Symposium at Ahvaz University of Medical Sciences in Ahvaz, Iran.

## HONORS AND AWARDS

- Partial tuition waiver scholarship, Johns Hopkins Bloomberg School of Public Health. 2009-14
- University of Florida Alumni Graduate Fellowship, 2001-06.
- Poe Family Business Ethics Fellow, University of Florida Warrington College of Business, 2000-01

## ACTIVITIES

- **Member**, Academy Health, Since May 2002
- **Member**, American Public Health Association, Since October 2000
- **Peer reviewer**, Public Library of Science (PLoS Medicine), Since 2007
- **Member and annual conference volunteer**, Global Health Council, Since May 2007
- **Student Representative**, DrPH executive decision, and curriculum development committee. Bloomberg School of Public Health, Johns Hopkins University, January 2009-January 2012
- **Elected Member**, Johns Hopkins University, Bloomberg School of Public Health, Student Assembly 2009-10
- **Invited Member**, University of Florida Graduate Assistants United advising committee on student health insurance schemas. September 2002-May 2003
- **Translator and conference volunteer**, TED, TEMED, and TEDxMidAtlantic. January 2010-Present

## **SKILLS**

### **Languages:**

- Native Fluency in English, and Persian (Farsi)
- Proficient in Arabic and Spanish

### **Computer software applications:**

- MySQL<sup>®</sup>, MS-Access<sup>®</sup> Database packages
- R<sup>®</sup>, SAS<sup>®</sup>, STATA<sup>®</sup>, SPSS<sup>®</sup>, Stats Pro<sup>®</sup>, EpiInfo<sup>®</sup>, TreeAge<sup>®</sup>, UCINET<sup>®</sup>, MS-Excel<sup>®</sup> (array formulas, pivot tables, charts, macros, VBA), and ARCGIS<sup>®</sup> analytical packages
- MS-Office<sup>®</sup>, Adobe Photoshop<sup>®</sup>, RefWorks<sup>®</sup>, End Note<sup>®</sup>, Pro Cite<sup>®</sup>, MS-Frontpage<sup>®</sup> and Adobe Dreamweaver<sup>®</sup> content management packages
- Various virtual classroom & conference packages
- MS-Windows<sup>®</sup> for IBM<sup>®</sup>-PC and Macintosh<sup>®</sup> platforms

## **REFERENCES**

Available upon request